AMERICAN MACHINIST

JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 13, No. 19. WEEKLY. | NEW YORK, THURSDAY, MAY 8, 1890. | $3.00 per Annum. SINGLE COPIES 6 CENTS.

COPYRIGHT 1890, BY AMERICAN MACHINIST PUBLISHING COMPANY.

For Sale Everywhere by Newsdealers.

ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

The Accident to the "City of Paris."

A good many surmises have been indulged in as to the cause of the disablement of the engines of the Inman liner "City of Paris," which occurred on the 25th of March. It was probably one of the most remarkable breakdowns of a steamship's engines that ever occurred, and hence, as well as from the enormous amount of engine power concentrated in a single vessel, great interest has been concentrated on the subject.

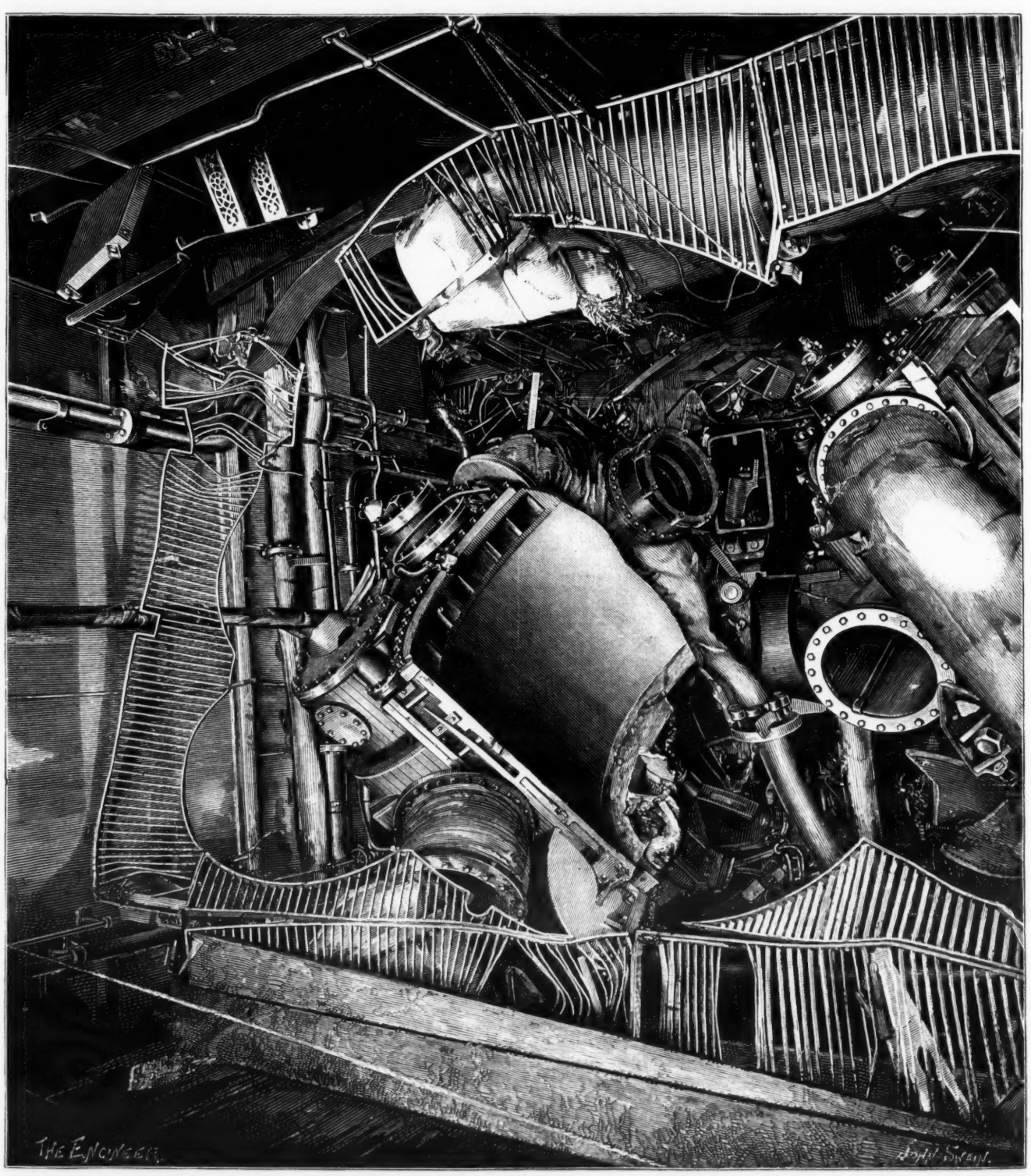
There is no doubt that the "City of Paris" is a safe vessel, and that, notwithstanding her engines were completely disabled for the time and both engine-rooms flooded, there was comparatively little danger of loss of life at any time. Our London contemporaries, *The Engineer* and *Engineering*, have given much attention to the matter, and were afforded the fullest facilities for investigations. From them the following facts regarding the accident have been taken. *Engineering* says, referring to the "City of Paris" after she had been docked:

"....The shafting passes through the skin plating in the usual way, and the outboard length of shafting is enclosed in a casing of steel plates. This casing extends up to the bracket which supports the after end of the shafting and it is attached to the ship's side for a certain distance by a web of steel, as shown. It became necessary to strip off this casing in order to make a proper examination, and Messrs. Laird Brothers, in whose hands the work had been placed, proceeded with the operation. Upon the casing being cast adrift, the whole of the outer lengths of shafting, with the propeller attached, fell into the bottom of the dock, one blade cutting deeply into the timber of the dock bottom, whilst another was curled up like a leaf. It was in this position that we saw the shafting and propeller on the morning of the 11th inst.

"Each of the twin shafts passes through the ship's side through a stern tube, as we have said, in the usual manner. Immediately outside there is a flange coupling of the ordinary description, by which attachment is made to the outboard length of shafting. It was immediately on the forward part of this coupling, and therefore directly outside the stern tube, that the starboard shaft was broken square across. . . . The diameter of this part of the shafting is 20¼ in. The fracture was thick with rust on both faces, but there was every appearance of the metal being sound throughout, and of excellent quality. On the whole, we should judge the shaft to be an excellent job, and the fracture to be entirely unconnected with any fault in the material. The outboard portion of the shaft abaft the coupling just referred to consists, we may say, of one length of hollow shafting 42 ft. long, and one length of solid shaft 15 ft. long, this latter length carrying the propeller. The total length of shafting abaft of the point of fracture was thus some 58 feet or so.

"This breakage of the shaft will of course fully account for the racing of the engine, while the subsequent damage done thereby can, we think, also be fully accounted for by causes we shall explain presently. In the first place, however, we will speak of the events which led to the fracture of the shaft. Proceeding aft in our examination of the vessel, we found the two arms of the stern bracket intact, their attachment to the vessel being undisturbed. At their outer ends they are, or rather were, connected by a cylindrical boss which forms the support in which the propeller shaft revolves, as shown. This boss, with the two arms and their palms by which they are attached to the hull, form one steel casting in the usual way. The thickness of metal in the cylindrical part is 3½ inches. This boss was fitted with the usual gun-metal bush and lignum-vitæ bearing strips. The cylindrical part of the casting was split clean across the top in a line with the axis. The reason of this was obvious; when the forward end of the broken shaft had commenced to fall, owing to losing the support of the casing, a twisting moment of considerable force was naturally exerted, and this the casting was unable to sustain. The length of the cylindrical part of the bracket is about 6 feet.

"We have said that the top part of the bracket was split across when the twisting strain was brought upon it by the release of the forward end of the outside shafting when the casing was cast adrift in the dock. It should be stated that the fracture was quite bright and free from rust, showing that it had recently been made. It will be further evident that the cylindrical part of the casting could not be intact on its bottom side, or the shaft would not be released. There was, however, no occasion for any fracture to occur here throughout, and this brings us to the most interesting part of our report. The bottom part of the casting was worn through for nearly the whole of its length, and much reduced in thickness where



THE WRECKED ENGINE OF THE "CITY OF PARIS."

not worn through. The metal liner, one inch thick, together with its end flanges, was also worn through, and was lying in the bottom of the dock. The brass sleeve of the propeller shaft had entirely disappeared, with the exception of two rings, presumably the collars at the end. The propeller shaft itself was practically undamaged, but the metal studs which attached the sleeve to the shaft were worn down level with the shaft, and the shaft was slightly worn also.

"This wearing away and consequent dropping of the end of the outer shafting we take to be the obvious primary cause of the whole mischief. Our readers will easily imagine the abnormal and altogether unprovided for stress thrown upon the shaft through its after end dropping some seven or eight inches, and the fracture naturally occurred exactly where one would expect, namely, adjoining the next point of support, the latter being provided by the stern tube where the shafting emerged from the ship's skin.

"What may have been the cause of the wear of the propeller shaft and its bearing and their support remains a question yet to be solved. Upon this we can offer nothing but surmise. The bearing was, as we have said, fitted with lignum-vitæ strips, in accordance with the usual practice, and it is an interesting point to determine what happened to these strips. Those who have had the best opportunity of forming an opinion on the subject are well agreed that the brass liner on the tail shaft probably burst, that the rough edge of this cut out the wood, and that the metals then came together and ground each other away, producing the state of things described. This certainly appears to be an extremely reasonable explanation of the facts."

After describing very graphically the complete wreckage of the engine, our contemporary says:

"We have now to say something respecting the secondary causes which contributed to such an entire destruction of the low-pressure engine as we have described. As we have already seen, the primary cause of the disaster was undoubtedly the wearing away of the boss of the bracket supporting the stern end of the propeller shafting, this leading to the fracture of the shafting outside the stern tube, and hence to the racing of the engines. Of course such racing, if unchecked, would of itself soon induce strains on the connections of the reciprocating parts amply sufficient to cause the destruction of the machinery; but, rapidly as this would occur, some brief interval would intervene before the necessary speed was attained, and from the fact that in the present instance—as far as can be gathered from the evidence available—the smash occurred almost immediately on the engines starting off, and before any effort could be made to shut off steam, it almost appears as if some special influence had been at work to effect at least a portion of the damage. One theory which has occurred to us, and which we consider at least worthy of some consideration, is as follows: It is well known that in the low-pressure cylinders of modern marine engines there is considerable difficulty in getting the amount of cushioning desirable to insure smooth running at the speeds now common, and hence there is every inducement to increase that cushioning (chiefly by inside lap on the low-pressure slide valves) to as great an extent as non-interference with a clear exhaust will permit. What the proportions were in the case of the engines of the 'City of Paris' we do not know, but probably they agreed with usual first-class practice. Now when the engines started to race two influences at once commenced to materially increase the compression in the low-pressure cylinder. In the first place, the condenser (fitted with separate circulating engine) received a great increase in the amount of steam it had to deal with, thus probably materially reducing the vacuum, and secondly, the increased piston speed would give rise to an increase in the difference between the back pressure in the cylinder and the pressure in the condenser. These causes would thus augment the pressure in the cylinder at the commencement of compression, and instead of being, say, as ordinarily, some four to five pounds per square inch absolute, it might readily rise to three times this amount or more. The effect of this would be to produce a serious pressure at the termination of the compression; and the valves on the low-pressure cylinder, being of the piston type, the only relief for this pressure would be through the ordinary relief valves—quite inadequate for such an emergency as this. It is very easy to conceive that such a condition of things as we have assumed might lead to the blowing off of the top cover of the low-pressure cylinder and other damage, which would leave the high-pressure and intermediate sections of the engine temporarily free to run as a non-condensing compound engine, thus accumulating speed which would complete the destruction. On this latter point we may observe that the strain on the connections due to the stopping and starting of the reciprocating parts would increase as the square of the speed, so that, even if these connections had as large a factor of safety as nine at the normal speed of the engines, this margin would have entirely disappeared by the time a threefold speed was reached.

"It may be said that the worst has happened, which could happen to the starboard low-pressure engine of the 'City of Paris.' A comparatively small cause has led to this great event, from which many important lessons may be learnt. The benefit of this experience will be shared not only by the owners of the 'City of Paris,' but by those interested in other large steamers of a similar kind; so that this breakdown will make a voyage across the Atlantic safer than before, and this advantage has been purchased without the loss of a single life, although at great sacrifice of property. The result of this mishap should be to strengthen the confidence the traveling public feel in these magnificent modern steamers. There is no time for judging of the excellence of workmanship and material like that afforded when a piece of mechanism is being broken up. Never was an engine more thoroughly broken up than that of the "City of Paris," and after a fairly complete examination of the debris we could see no place where faulty material or workmanship were to be found—no sacrificing efficiency to economy. Had not the ship been of such excellent design and construction she would not be afloat now. It is unlikely that such a remarkable train of untoward events will ever occur again, but even if they do there are certain to be the additional precautions, growing from past experience, to meet them."

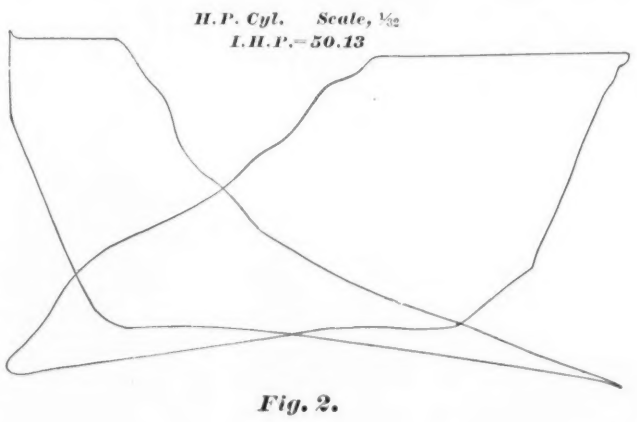


Fig. 2.

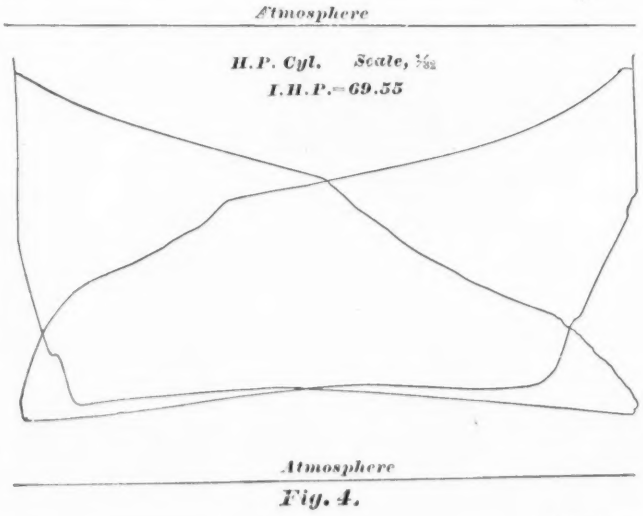
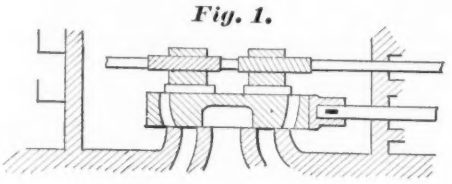


Fig. 4.

Fig. 1.



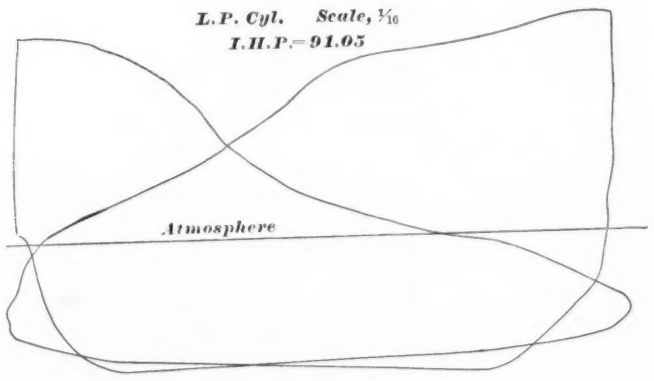


Fig. 3.

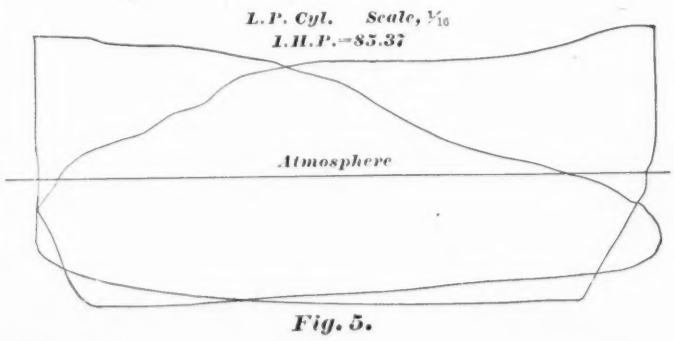


Fig. 5.

COMPOUND LOCOMOTIVES.

We give on our first page an engraving reproduced from *The Engineer*, the original being made from a photograph, which was taken by pointing a camera down into the engine-room from one end of the skylight above it. It includes the after part of the starboard engine-room only, where the low-pressure cylinder was situated, the intermediate and high-pressure cylinders being almost uninjured.

The large cylinder, which was 113 inches in diameter, and weighed in the rough, with its four valve-boxes which were cast on, about 45 tons, was split in two vertically athwartships, the most prominent object in the engraving being a fragment of it, near the center, comprising about half the cylinder. Immediately to the right of this the low-pressure crank is seen, with the connecting rod still attached, and pointing off towards the starboard side. This rod, which is 11¼ inches diameter at the largest part, is bent. The piston rod is still attached to it, and is seen lying folded back to the left of the connecting rod. The collar on this piston rod to which the piston was attached is seen with the bolts used to secure the piston, still in place, the latter having been completely broken away. Above this collar is the continuation of the piston rod, called the tail rod, which passed up through the upper cylinder cover. This cylinder cover was found under pretty much everything else.

The piston rod is 10 inches diameter, of mild steel, the tail rod being 8 inches diameter.

The grating which surrounds the wreck was one of the three platforms upon which the engineers stood—we should judge the lower one—the others being at the level of the links and at the top of the cylinders. The two A frames which supported this cylinder were steel castings, weighing about 14 tons each; the piston 10 tons; piston rod 3 tons; crosshead 2 tons; and connecting rod 7 tons; the total weight of the principal moving parts, exclusive of the crank, being about 22 tons. Nothing which was breakable seems to have been left unbroken, and what could not be broken was bent. The editor of *The Engineer* says that nothing seems to have given way, except as the result of the utmost violence, the fractures showing excellent material throughout.

The flooding of the engine-rooms was caused by the fact that the flying parts of the engine demolished the surface condenser, allowing the water which came to it, through a pipe 24 inches diameter, to flow into the engine-room. At the same time the bulkhead which separated the two engine-rooms was pierced in several places, so that both were flooded, and the vessel rendered helpless.

The Secretary of the Navy has issued a circular announcing that both the 5,500-ton and the 8,100-ton cruisers, recently advertised for by the department, must be completed by Jan. 1, 1893, or about two and a half years from the date of the contracts, if any are made under the first advertisement. In the original proposal the time for the 5,500-ton vessel was stated at two and a half years, and for the other at three years.

Compound Locomotives.

BY W. H. BOOTH.

It is well recognized in condensing engines that it does not pay to expand steam much if any lower than to one-half an atmosphere.

In non-condensing engines, the point to which expansion can be carried is necessarily above the atmospheric line, but just what the lowest point may be cannot exactly be known in the absence of sufficient experimentally determined data. It is, however, tolerably certain that it cannot well be less than about 18 pounds absolute, or a full 3 pounds above the atmospheric line. Approximately we may say that the lowest terminal pressure in the high-pressure engine will be somewhere about double what it is in the condensing engine. Taking 75 pounds absolute as the minimum pressure of steam to be worked in a compound condensing engine, we may double this, and say that steam of less than 150 pounds absolute or 135 pounds gauge pressure cannot well be worked to advantage in a compound locomotive, but that, when the compound principle is introduced, it should be accompanied by a rise in pressure beyond 150 pounds. Then taking a terminal

pressure of 18 pounds, an expansion of about 8 times would give this, and the cut-off in the first cylinder would be made at 35 per cent. of the stroke or $\frac{100}{\sqrt{8.0}}$, whilst he cylinder ratio would be from 2½ to 3, and the low-pressure cut-off correspondingly early.

It has been stated that a non-condensing engine cannot be economically compounded, and this same statement has been as emphatically denied with the further statement that no account whatever need be taken of the fact that the atmosphere is present in one case, and removed in the other. As a fact, however, the cases are very different, and the absence of a condenser makes the difference, which may, as the above will indicate, be simply taken to account by an allowance all through of double pressures, *i. e.*, double terminal pressures and double initial pressures for equal rates of expansion.

Before it would pay to adopt triple expansion in a locomotive, the boiler pressure would be somewhere about 275 pounds as a minimum, all because the minimum terminal of 18 pounds reduces the number of expansions practicable or rather advisable; for it is clear that to expand below the atmospheric pressure would be useless, as, on the opening of the exhaust, the air would rush back towards the cylinder from the exhaust pipe, and the pressure against the piston on the return stroke never could be less than the atmosphere. When the blast pressure is taken into the calculation, it is very clear that the back pressure cannot be taken below 18 pounds absolute as a rule, and therefore the number of expansions for any pressure cannot be taken as more than half the expansions possible in the condensing engine. All this seems to have been overlooked by many who have advocated the compounding of locomotives, and, so far as present steam engineering goes, the principle should not be applied under about 150 pounds, as above stated. Indeed, it might almost be said to be above this.

The difficulty with the simple locomotive so far has been the valve gear. The use of the link motion for high expansions gives such severe compression of the exhaust that the power of the engine is much reduced, and the power of the engine is curtailed doubly, once by reduction of the mean forward pressure, and again by increase of back pressure. Were some good cut-off gear possible with the main valve, always set suitably for the moderate compression, which alone is needed, then the engine power would be a function merely of the speed and mean forward pressure, and no increase in the back pressure need occur beyond such as might arise from rapid piston motion and exhaust ports too small to prevent rise in back pressure. Now, a simple engine fitted with a variable separate cut-off valve would be far handier than the compound engine, for it could work at full power and at any early cut-off, and up to 150 pounds would accomplish all that is needful in the way of expansion.

There are certain difficulties connected with the application of cut-off valves to locomotives, which require consideration. In the first place, both the main valve and the cut-off valve require to be varied at different times.

The main valve requires working by the link motion or its equivalent, and for reverse running the link motion must be moved over just as in an ordinary engine, but with this difference, that the link will always be in the full gear position; there will be two notches only in the quadrant, one for full forward gear, the other for full back gear and every change of expansion will be made by the cut-off valve. The arrangement of cut-off gear, which embodies a cut-off plate, sliding upon the back of the main valve, may be variously designed. It may be arranged so that the cut-off valve has an angular advance of 90°, in which case the engine will run equally well in both directions; but for engines expressly designed for running almost invariably in forward gear, as the engines of fast express trains always do, the valve gear may be arranged so that the cut-off eccentric has a position somewhat different, and a lead more suitable for forward than for backward running. The disadvantages of cut-off gears are, first, that three eccentrics are required, and for inside cylinder engines this alone would be a sufficient cause to prevent their adoption; but for outside cylinders such would not be the case, as there is room on the axle for more than six eccentrics.

In the well-known arrangement of Meyer, (Fig. 1, page 2,) in which the cut-off plate is in halves, which can be moved apart or together by right and left screws on the valve spindle, the main valve would be simply driven by a link motion always in full forward or back gear, and the simple reversal of the engine by the main valve lever would equally reverse the engine, as though no cut-off valve were present if the cut-off eccentric had a 90° lead, and even without the 90° lead the handling of the engine would not be complicated or difficult.

It would be merely that the cut-off would vary somewhat between forward and back gear, according as the angle of lead of the cut-off eccentric varied from 90°. This would be a small matter, and only operative when backing on to a train or out of a shed, and against it would be set all the advantage of better steam distribution throughout a day's run. With a cut-off valve, then, there would be small back pressures at all speeds, full power developed from the forward steam pressure, and perfectly easy reversibility. The variation in cut-off would be effected quite apart from the reverse lever and be regulated by means of a hand-wheel through a light shaft and gearing which would revolve the cut-off valve spindle to give outward or inward motion to the cut-off plates. This is often done in stationary engines by attaching a toothed wheel to the cut-off valve spindle outside the valve chest, and actuating this by means of a long toothed pinion on a spindle worked by the hand-wheel, the length of face of pinion being equal to that of the valve spindle wheel plus the travel of the cut-off valve; the two gears are always in contact and the spindle of the valve can be rotated at will or from the governor. In a locomotive it would of course be worked from the cab. Many other devices have been brought out to fulfill the same purpose, but it is doubtful if any are at once so effective and simple as the Meyer type or admit of so large a range of action whilst not adding to the embarrassment of the engine driver.

The present frequency of screw and steam reversing gears is very little different from the screw gear necessary to vary the cut-off with a Meyer valve gear.

In a compound locomotive a quite high rate of expansion can be attained without separate cut-off valves, but the necessity is recognized in compound locomotives of a certain minimum cylinder capacity—below which, under certain full-powered conditions, the engine would fall short of the simple locomotive. High speed seems to be a prime requisite to develop and render apparent the powers and advantages accruing with compound working.

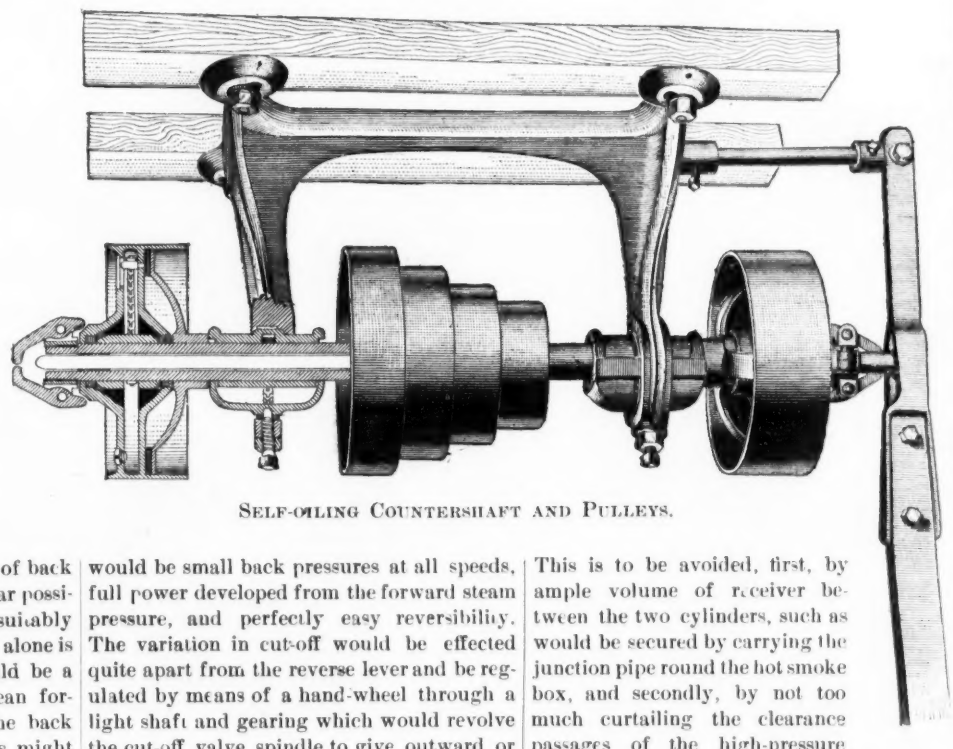
When steam is worked down to a lower pressure it has less power to escape through a given orifice, the weight of steam escaping at any given opening being proportionate to the absolute pressure, three times as much steam escaping through an opening of a square inch area at 90 pounds as will pass at only 30 pounds. Approximately this rule holds good at lower pressures than 30 pounds, and from this arises the necessity, when designing the low-pressure cylinders of compound engines, to design them with ample port areas, for, if this be not done, the back pressures and loss of pressure between cylinders is likely to be excessive. It is not then merely necessary that a cylinder of 30 inches diameter should have a given steam port area, whatever be its pressure of working; for, if the cylinder be the first cylinder of a compound engine it will require less ample ports than if it is intended as the second cylinder. To a large extent the admission originally of less steam per stroke may render special care less necessary, but it is always well that the low-pressure ports be of good and sufficient size, and also that the low-pressure exhaust be opened well before the end of the stroke, in order that the back pressure may fall to the pressure of the blast orifice by the commencement of the return stroke or nearly so.

As regards the high-pressure cylinder, if the low-pressure admission is, as it should be, made short, there is a tendency towards excessive compression in the first cylinder. This is to be avoided, first, by ample volume of receiver between the two cylinders, such as would be secured by carrying the junction pipe round the hot smoke box, and secondly, by not too much curtailing the clearance passages of the high-pressure cylinder, so that, when the high-pressure exhaust closes, the pressure shall not be too much intensified. This difficulty, of course, of compression of residual steam, is greater when the low-pressure valve cuts off early and backs up the receiver pressure; for the high-pressure clearance spaces are left full of steam at the receiver pressure, and the final pressure is therefore correspondingly higher than when the low-pressure cylinder is carelessly left to take steam throughout its stroke.

As in stationary and marine work, the necessity is equally pressing in locomotive work, not to neglect the second cylinder, but rather to treat it with all the care possible. In the distribution of careful attention about the compound engine, the one thing of paramount importance as regards the first cylinder is to keep it hot, and as regards the second cylinder, to get a well-shaped indicator card from it, not a mere wire-drawn sloping line. It is, of course, well to keep the low-pressure hot also; but this difficulty is less pressing than it is with the first cylinder. The annexed diagrams, recently taken by me from a compound engine—not a locomotive—show the results of earlier cut off.

Each cylinder had the Stephenson link reversing gear, and Trick valves with relief back plates, and both links were varied by one hand gear being on the same weight-bar shaft. Hence a linking up of the high-pressure valve was accompanied by a similar action of the low-pressure valve, as it should be. Diagrams 2 and 3 show the earlier cut-off with wider throttle, the diagrams 4 and 5 having the throttle partially shut.

The variation in the relative power of the two cylinders is to be noted. That practice in compound locomotives is wrong, which leaves the low-pressure cylinder to perform a smaller part of the work than the high-pressure cylinder. In the two sets of diagrams a larger power is developed in the large cylinder when the total power is least, owing to the variation in the cut-off, more than the whole difference of total power being obtained in the small cylinder by making the cut-off later and showing well the action of this. This special engine had cylinders whose ratio was 1 : 2.3. This ratio was adopted for special reasons, the engines being intended to work separately as well as compound, or otherwise the ratio would have been different, the gauge boiler pressure being 90 pounds.



SELF-OILING COUNTERSHAFT AND PULLEYS.

Self-oiling Countershaft and Pulleys.

The accompanying illustration represents a countershaft with self-oiling pulleys and bearings, just brought out and patented by the States Machine Co., Railroad place, Newark, N. J. It will be seen that the hangers are cast in one piece, the bearings are self-aligning, and the shipper attached to the hanger; in fact, the device is designed to be placed and bolted wholly in position. The pulleys are placed outside of the hangers, and are loose on the shaft. The shaft is hollow, and a shipper rod is passed through it, to engage with two simple and positive friction clutches, one being screwed to each end of the shaft.

The left-hand side of the illustration shows a section of the clutch, pulley and bearing; it shows the clutch disengaged from the rod, allowing the pulley to revolve freely on the shaft. When this pulley is to be put in action the rod is forced, by means of the shipper handle, between the two clutch levers, and these in turn force the pulley against a disk which is fastened to the shaft; this disk is shown between the pulley and the bearing. The surface of contact, or friction surface, is near the belt surface of the pulley, giving the disk a greater power to hold the pulley than if the friction surface had been of smaller diameter. In order to further increase the holding capacity of the disk, the surface of contact on the pulley is lined with paper, made specially for the purpose. In a similar way the pulley on the right is put in action. When one of these pulleys is engaged, the other one is disengaged; or, when the shipper rod is placed in a midway position, both pulleys revolve freely on the shaft.

The rim of the pulley is supported by two disks cast to, and extending from the rim to the hub; the space between these disks forms an oil reservoir. In this reservoir a small chain passes over the shaft, and over a stud near the rim of the pulley. As the pulley revolves, the centrifugal force throws the oil towards the rim, and from there the oil is carried in large quantities by the chain to the shaft. All the superfluous oil on shaft is trapped near the end of the hub of the pulley, and conveyed back through small holes drilled in the hub, and communicating with reservoir, into the latter, and again thrown by the centrifugal force towards the rim. By these means the shaft is supplied with continuous flow of oil, without spilling a drop. The outer disk of the pulley is provided with a small opening covered with glass, through which the amount of oil in the reservoir can be seen.

The bearings in the hangers are also oiled by means of a chain resting on the shaft and extending into the oil reservoir below.

Since both pulleys are on the outside of the hangers, the belts can be thrown off without unlacing. The shipper can be detached by loosening one set screw.

The countershaft and hangers require less room than the ordinary ones; they require no attention except to give them a new supply of oil once in six months to a year. These shafts have been put into practical use, and are giving excellent satisfaction.

Odontics, or the Theory and Practice of the Teeth of Gears.

By GEO. B GRANT.

THIRD PAPER.

35.—THE CIRCULAR PITCH.

The distance *a O*, Fig. 14, covered by each tooth upon the pitch circle, is commonly called the "circular pitch," and often the "circumferential pitch." The term "pitch arc" is the most appropriate, but is not in common use.

This was formerly the measurement by which the size of the tooth was always stated, a tooth being said to be of a certain "pitch," and all of its other dimensions being expressed in terms of that unit, but it is fast being replaced, and should be entirely replaced, by the more convenient "diametral pitch" unit.

The circumference of a circle is measured in terms of its diameter by means of an incommensurable fractional number 3.14159, called π (pi), and, therefore, if the tooth is measured upon the arc of the circle by means of the circular pitch, one of two inconveniences must be tolerated. Either the pitch must be an inconvenient fraction, or else the pitch diameter must be as inconvenient, for the gear cannot have a fractional number of teeth. The fractional calculations are so clumsy that a table of pitch diameters corresponding to given numbers of teeth should be used, and errors in the laying out of the work are of constant occurrence.

Again, outside of the liability of error in making calculations, the circular pitch system is a constant source of error in the hands of lazy or incompetent draftsmen or workmen, for there is a constant temptation, often yielded to, to force the clumsy figures a little to produce some desired result. For example, a millwright has to make a gear of fourteen inches pitch diameter with fourteen teeth. He finds by the usual computation that the circular pitch is 3.14 inches, and, as his odontograph has a table for three-inch pitch, he uses that with the remark that it is "near enough," laying the blame on the odontograph or on the iron founder if the resulting gear roars. His next order is for a gear of one-inch pitch to match others in use, and to be fourteen and a half inches diameter. The circumference of the pitch line is 45.53 inches, and he has his choice between 45 and 46 teeth, both wrong. Perhaps the most frequent cause of error is that the workman is apt to apply a rule directly to the teeth of a gear he is about to repair or match, to get the circular pitch, and the result is more likely to be wrong than right.

The best plan when using this unit is to get convenient pitch diameters and let the pitch come as it will, provided that gears that work together are of the same pitch, and that is simply a roundabout way of using the diametral pitch unit.

When the circular pitch must be used the following table will greatly assist the work and save calculation. For example, the pitch diameter of a gear of three-quarter-inch pitch and 37 teeth is three-quarters the tabular number 11.78, or 8.84 inches.

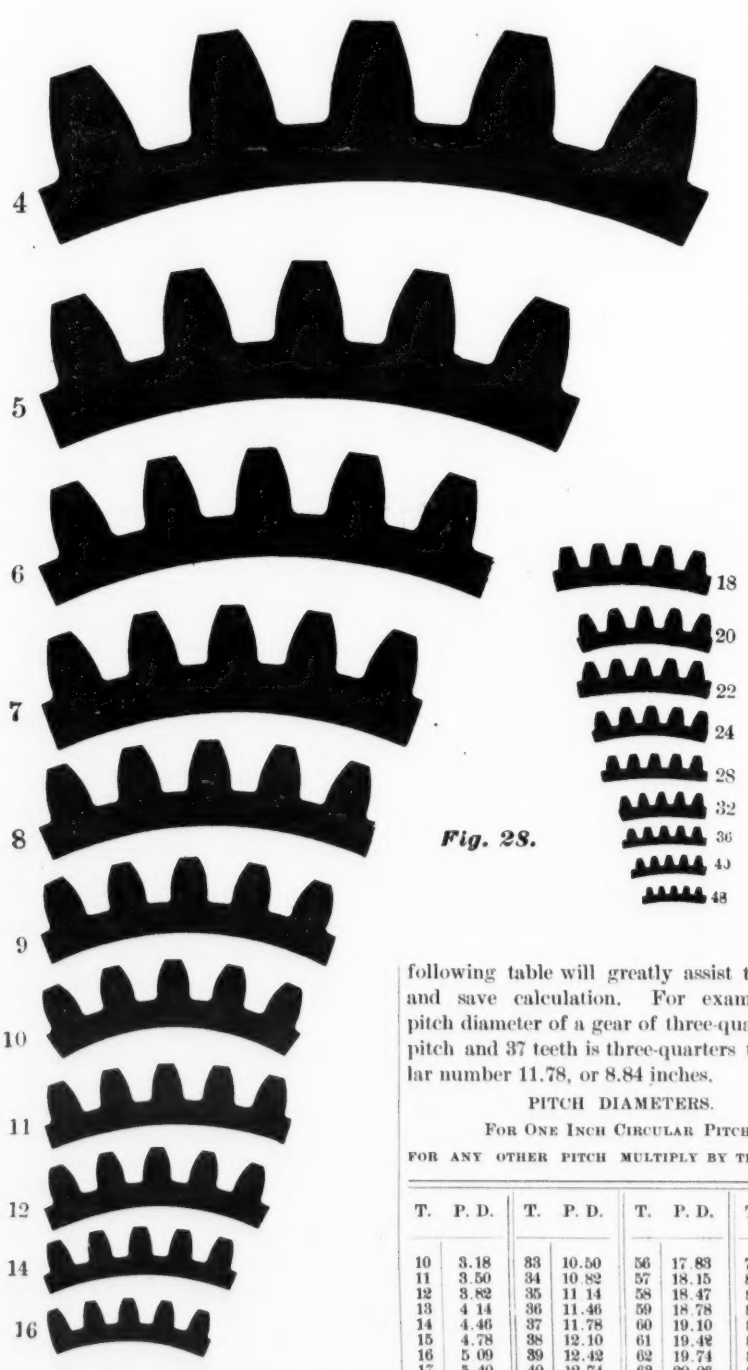


Fig. 28.

PITCH DIAMETERS.

FOR ONE INCH CIRCULAR PITCH.

FOR ANY OTHER PITCH MULTIPLY BY THAT PITCH.

T.	P. D.	T.	P. D.	T.	P. D.	T.	P. D.
10	3.18	33	10.50	56	17.83	79	25 15
11	3.50	34	10.82	57	18.15	80	25.47
12	3.82	35	11 14	58	18.47	81	25.79
13	4 14	36	11.46	59	18.78	82	26.10
14	4.46	37	11.78	60	19.10	83	26 43
15	4.78	38	12.10	61	19.42	84	26.74
16	5 09	39	12.42	62	19.74	85	27.06
17	5.40	40	12.74	63	20.06	86	27.38
18	5.73	41	13.05	64	20.38	87	27.70
19	6.05	42	13.37	65	20.69	88	28 02
20	6 37	43	13.66	66	21.02	89	28.34
21	6 69	44	14.00	67	21.33	90	28.65
22	7.00	45	14.33	68	21.65	91	28 97
23	7.32	46	14.65	69	21.97	92	29.29
24	7.64	47	14 96	70	22.29	93	29.60
25	7.96	48	15.28	71	22.60	94	29.93
26	8.28	49	15.60	72	22.92	95	30.25
27	8.60	50	15.92	73	23.24	96	30.56
28	8.90	51	16.24	74	23.56	97	30.88
29	9.23	52	16.56	75	23.88	98	31.20
30	9.55	53	16.87	76	24.20	99	31.52
31	9.87	54	17.19	77	24.52	100	31.84
32	10.19	55	17.52	78	24.83		

36.—THE DIAMETRAL PITCH.

This is not a measurement, but a ratio or proportion. It is the number of teeth in the gear divided by the pitch diameter of the gear. Thus, a gear of 48 teeth and 12 inches pitch diameter is of 4 pitch. The advantages of the diametral pitch unit are so apparent that it is fast displacing the circular pitch unit, and has almost entirely displaced it for cut gearing. It is so simple that a table of pitch diameters is entirely useless, although such useless tables have been published.

The diametral pitch is sometimes defined as the number of teeth in a gear of one inch diameter. It is a common, but bad practice, to designate diametral pitches by numbers, as No. 4, No. 16, etc.

37.—RELATION OF PITCH UNITS.

The product of the circular pitch by the diametral pitch is the constant number 3.1416, so that if one is given the other is easily calculated.

The following tables of equivalent pitches will be convenient in this connection.

Diametral Pitch.	Circular Pitch.	Circular Pitch.	Diametral Pitch.
2	1 571 inch	2	1 571
2¼	1.396 "	1⅞	1 676
2½	1 257 "	1¾	1.795
2¾	1.142 "	1⅝	1 933
3	1.047 "	1½	2 094
3½	.898 "	1⅜	2 185
4	.785 "	1¼	2 285
5	.628 "	1⅛	2 394
6	.524 "	1	2.513
7	.449 "	⅞	2.646
8	.393 "	¾	2.793
9	.349 "	11/16	2.957
10	.314 "	1	3.142
11	.286 "	15/16	3 351
12	.262 "	⅞	3.590
14	.224 "	13/16	3.867
16	.196 "	¾	4.189
18	.175 "	11/16	4.570
20	.157 "	⅝	5.027
22	.143 "	9/16	5.585
24	.131 "	½	6.283
26	.121 "	7/16	7.181
28	.112 "	⅜	8.378
30	.105 "	5/16	10 053
32	.098 "	¼	12 566
36	.087 "	3/16	16.755
40	.079 "	⅛	25.133
48	.065 "	1/16	50.266

38.—ACTUAL SIZES.

Figs. 28 and 29 show the actual sizes of standard teeth of the usual diametral pitches, and give a better idea of the actual teeth than can be given by any possible description. They are printed from cut teeth, and may be depended upon as accurate.

39.—ADDENDUM AND DEDENDUM.

The tooth is limited in length by the circle *a l*, Fig. 30, called the addendum line, and drawn outside the pitch line at a given distance, called the addendum. Its depth is also limited by a line *r l*, called the dedendum or root line, drawn at a given distance inside of the pitch line.

The addendum and the dedendum are both arbitrary distances, but, for convenience in computation, they are fixed at simple fractions of the unit of pitch that is in use. When the circular pitch is used the addendum is one-third of the circular pitch.

When the diametral pitch unit is used the addendum is one divided by the pitch.

It is customary to make the addendum and the dedendum the same, except in certain cases where some special requirement is to be satisfied.

40.—THE CLEARANCE.

To allow for the inevitable inaccuracies of workmanship, especially on cast gearing, it is customary to carry the tooth space slightly below the root line to the clearance line *c l*, Fig. 30.

The clearance, or distance of the clearance line inside of the root line is arbitrary, but it is convenient and customary to make it one-eighth of the addendum.

41.—THE BACK-LASH.

When rough wooden cogs or cast teeth are used, the irregularities of the surface, and inaccuracies of the shape and spacing of the teeth, require that they should not pretend to fit closely, but that they should clear each other by an amount *b*, Fig. 30, called the back-lash.

The amount of the back-lash is arbitrary, but it is a good plan to make it about equal to the clearance, one-eighth of the addendum.

Skillfully made teeth will require less

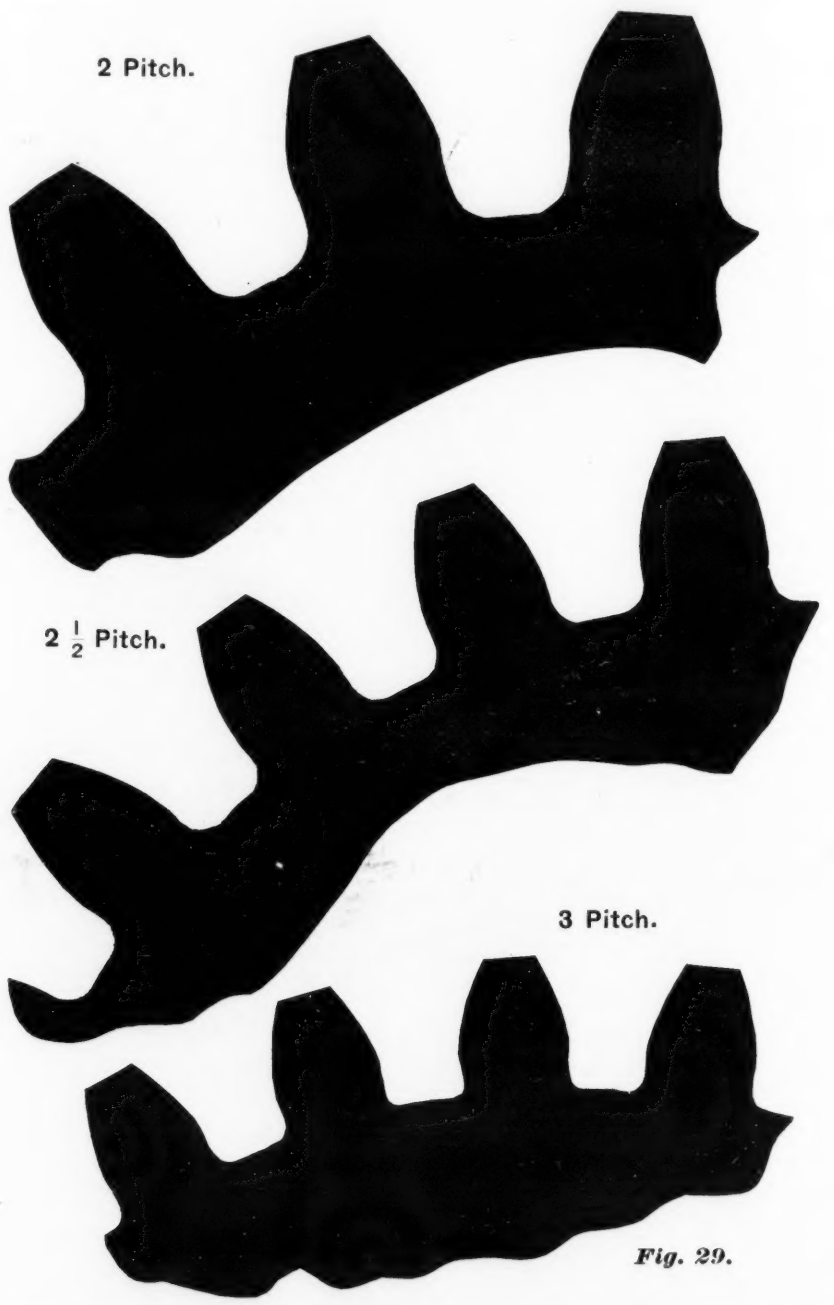


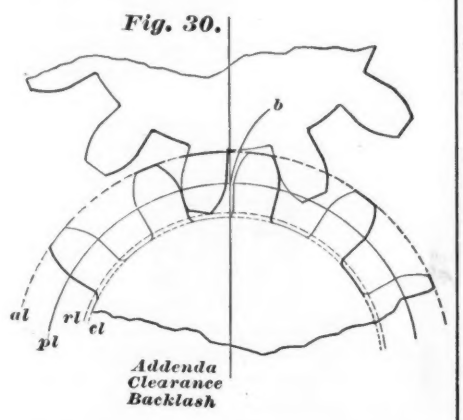
Fig. 29.

back-lash than roughly shaped teeth, and properly cut teeth should require no back lash at all. Involute teeth require less back-lash than cycloidal teeth.

42.—THE STANDARD TOOTH.

The tooth must be composed of odontoids, preferably of odontoids of which the properties are well known, and an advantage is gained if it is still further confined to a particular value of that odontoid. If the teeth

Fig. 30.



are to be drawn by an odontograph some standard must be fixed upon, since the method will cover but one proportion of tooth.

For example, the standard involute tooth is that having its line of action inclined at an angle of obliquity of fifteen degrees. For the cycloidal system the standard agreed upon is the tooth having radial flanks on a gear of twelve teeth.

43.—ODONTOGRAPHS.

The construction of the tooth is generally not simply accomplished by graphical means, as it is generally required to find points in the curve and then find centers for circular arcs that will approximate to the curve thus laid out.

It is sometimes attempted to construct the curve by some handy method or empirical rule, but such methods are generally worthless.

An odontograph is a method or an instrument for simplifying the construction of the curve, generally by finding centers for approximating circular arcs without first finding points on the curve, and those in use will be described.

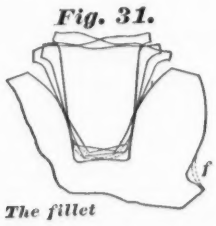
44.—THE FILLET.

When the teeth are laid out by theory there will be a portion of the tooth space at the bottom that is never occupied by the mating tooth. Fig. 31 shows a ten-toothed pinion tooth and space with a rack tooth in three of its positions in it, showing the unused portion by the heavy dotted line.

If this unused space is filled in by a "fillet" *f* the tooth will be strengthened just where it needs it the most, at the root.

The fillet is dependent on the mating tooth, and is therefore not a fixed feature of the tooth. If a gear is to work in an interchangeable set, it may at some time work with a rack, and therefore its fillet should be fitted to the rack; but if it is to work only with some one gear it may be fitted to that. The light dotted line shows the fillet that

Fig. 31.



The fillet

would be adapted to a ten-toothed mate. The fillet to match an internal gear tooth would be even smaller than that made by the rack.

When the tooth is formed by the molding process of (27), or by the equivalent planing process of (28), the fillet will be correctly formed by the shaping tool, but not so when the linear process of (29) is used. When the tooth is drawn by theory or by an odontograph the fillet must be drawn in, and can be most easily determined by making a mating tooth of paper, and trying it in several positions in the tooth space, as in the figure.

Except on gears of very few teeth the strength gained will not warrant the trouble of constructing the fillet.

45.—THE EQUIDISTANT SERIES.

When arranging an odontograph for drafting teeth, or a set of cutters for cutting them, we must make one sizing value do duty for an interval of several teeth, for it is impracticable to use different values for two or three hundred different numbers of teeth. The object of the equidistant series is to so place these intervals that the necessary errors are evenly distributed, each sizing value being made to do duty for several numbers each way from the number to which it is fitted, and being no more inaccurate than any other for the extreme numbers that it is forced to cover.

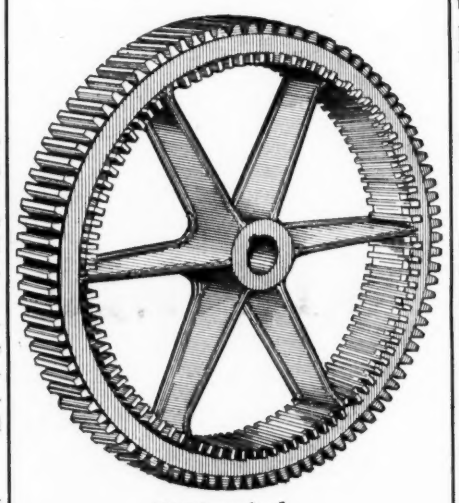
This series is readily computed for any case that may arise, and with a degree of accuracy that is well within the requirements of practice; by the formula

$$t = \frac{a\,n}{n - s + \frac{a\,s}{z}}$$

in which a is the first and z is the last tooth of the interchangeable series to be covered; n is the number of intervals in the series, and s is the number in the series of any interval of which the last tooth t is required.

For example, it is required to compute the series here used for the cycloidal odontograph, having twelve tabular numbers to cover from twelve teeth to a rack.

Putting $a = 12$, $z =$ infinity, and $n = 12$, the formula becomes



Mortise wheel

Fig. 32.

$$t = \frac{12 \times 12}{12 - s + \frac{12\,s}{\infty}} = \frac{12 \times 12}{12 - s + o} = \frac{144}{12 - s}$$

and then, by putting s successively equal to 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12, we get the series of last teeth, $13\frac{1}{11}$, $14\frac{2}{5}$, 16, 18, $20\frac{4}{7}$, 24, $28\frac{4}{5}$, 36, 48, 72, 144, and infinity. These give the required equidistant series of intervals.

12

13 to 14,	25 to 29,
15 to 16,	30 to 36,
17 to 18,	37 to 48,
19 to 21,	49 to 72,
22 to 24,	73 to 144,
	145 to a rack ;

and the method is as easily applied to any other practical example.

This formula and method is independent of the form and of the length of the tooth, and therefore is applicable to all systems under all circumstances. This is proper and convenient, for these elements can be eliminated without vitiating the results or destroying the "equidistant" characteristic of the series. The formula is an approximation based upon an assumption, but nothing more convenient or more accurate has so far been devised by laboriously considering all the petty elements involved.

The sizing value, or number for which the tabular number is computed, or the cutter is accurately shaped, can best be placed, not at the center of the interval, but by considering the interval as a small series of two intervals, and adopting the intermediate value. The sizing value for the interval from c to d is given by the formula

$$v = \frac{2\,c\,d}{c + d}.$$

Thus, the sizing value for the interval from 37 to 48 teeth should be 41.8, and that for the interval from 145 to a rack should be 290.

It is sometimes the practice to size the cutter for the lowest number in its interval, on the ground that a tooth that is considerably too much curved is better than one that is even a little too flat. This makes the last tooth of the interval much more inaccurate than if the medium number was used.

46.—THE HUNTING COG.

It is customary to make a pair of cast gears with incommensurable numbers of teeth so that each tooth of each gear will work with all the teeth of the other gear. If a pair of equal gears have twenty teeth each, each tooth will work with the same mating tooth all the time; but if one gear has twenty and the other twenty-one teeth, or any two numbers not having a common divisor, each tooth will work with all the mating teeth one after the other.

The object is to secure an even wearing action; each tooth will have to work with many other teeth, and the supposition is that all the teeth will eventually and mysteriously be worn to some indefinite but true shape.

It would seem to be the better practice to have each tooth work with as few teeth as possible, for if it is out of shape it will damage all teeth that it works with, and the damage should be confined within as narrow limits as possible. If a bad tooth works with a good one it will ruin it, and if it works with a dozen it will ruin all of them. It is the better plan to have all the teeth as near perfect as possible, and to correct all evident imperfections as soon as discovered.

47.—THE MORTISE WHEEL.

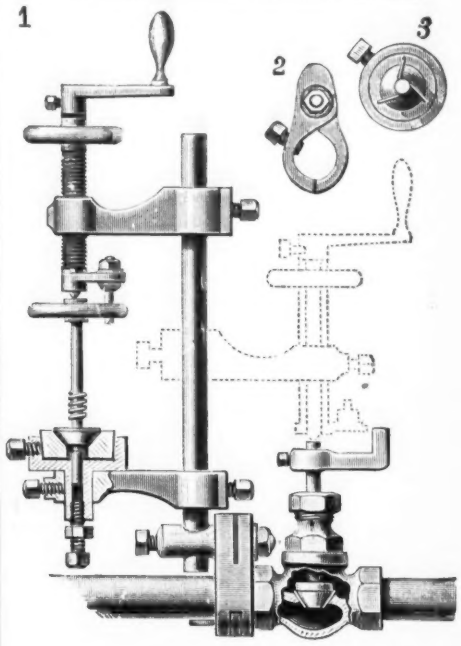
Another venerable relic of the last century is the "mortise" gear, Fig. 32, having wooden teeth set in a cored rim, in which they are driven and keyed.

Where a gear is subjected to sudden strains and great shocks, the mortise wheel is better, and works with less noise than a poor cast gear, and will carry as much as or more power at a high speed with a greater durability. But in no case is it the equal of a properly cut gear, while its cost is about as great.

In times when large gears could not be cut, and when the cast tooth was not even approximately of the proper shape, the mortise wheel had its place, but now that the large cut gear can be obtained the mortise gear should be dropped and forgotten.

The palisades extend from up the Hudson River until they lose themselves in New York Bay, dividing Hoboken and the lower part of Jersey City from Jersey City Heights by a wall, as it were, which grows less and less in sheer declivity as the bay is approached. Before the construction of the elevated cable road a street car line carried passengers from the Hoboken ferry to the Heights. Up and down the declivity—the palisades—the car went onto a truck platform and was hoisted or lowered by a stationary engine. When the elevated road was built this street car line lost its usefulness, and the hoisting plant bid fair to go to decay. But a couple of the engineers who formerly attended to hoisting and lowering the cars being "out of a job," pondered upon the devious and long route teams had to make in gaining the Heights from Hoboken and parts of Jersey City, so they rented the plant, and, for a year or more, have operated it in bodily transporting horses and wagons from one level to the other. It saves a good deal of time, and the enterprising workmen are doing very well in their venture.

It is proposed to use the spectroscope to determine whether cesspools, stables, etc., drain into neighboring wells. A solution of carbonate or chloride of lithium is poured into the suspected sources of pollution in the neighborhood, and after a week or so the well water is examined spectroscopically for lithium, which can thus be detected even if the water holds in solution less than one pint in a million.



Machine for Repairing Globe Valves.

We give with this an illustration of a device for milling the seats and disks of globe valves in place, recently patented by Mr. Geo. W. Holingsworth, 634 North 34th street, Philadelphia.

The cut shows the device in position for milling the disk, the cutter (No. 3) being put in its place in the lower arm, and the disk centered at each end as in a lathe, while it is turned by means of the hand crank, and fed down to the cutter by the screw and hand wheel.

The lower center rests upon a spiral spring, which allows it to recede as the disk is fed downwards, the tension upon this spring being adjustable by the set-screw and jam-nut below.

The dotted outlines show the device in position for milling the seat, for which purpose the arm is simply swung around upon the standard, and the cutter, which has a dog fastened to its upper end, is driven and fed down in the same manner as the disk has been.

Clamps (No. 2) are furnished for pipes of any size. With such a machine as this it becomes a comparatively simple matter to keep globe valves in good shape, and we have little doubt that there are many establishments where its cost would soon be saved, to say nothing of the satisfaction always resulting from valves which perform the office of valves, *i. e.*, let steam through when wanted, and shut it off when not wanted.

Woman and Wages.

Combination among skilled woman workers is increasing every day, though slowly, for women are naturally conservative, and they do not readily accept the principle of unionism. They have, many of them, suffered sorely from the effect of strikes, and though they realize that prolonged combination, if carried out consistently, must improve their position and in the long run raise their wages, never lose sight of the long period during which their employment must cease till their ultimate demands are conceded. Added to which they do not forget the bitter feelings aroused—the breach between employer and servant, and above all, that in a struggle such as a long strike always must be it is only the strong who win; the weak ones go to the wall.

All these things make women shy and slow to join a trade union, while the introduction of foreign labor in England and the increasing demand, on account of their cheapness, for foreign goods, have made a much deeper impression on their minds than is generally admitted. The skilled woman worker has, however, the security of knowing that she can take her stand with a greater chance of success, for with the best women workers, as with the men, the supply is rarely in excess of the demand. And were technical instruction given to women, a good deal of the better class work they cannot do would be carried out in England, instead of being executed by

French women, who are trained for it in the many technical schools which exist for women in France.

In Scotland the question has been warmly espoused by the women who work in Glasgow and Dundee, and the prospect of combining for the unskilled as well as for the skilled workers is very much more promising than in England. Scotch women are more independent and self-reliant, added to which, though the pay is bad, their surroundings are less deteriorating than those of the London women, and their dwellings are better and rents are lower.

The rapid increase of the population and the influx of people from the country to the large towns make the problem of how to deal with our unskilled female labor every year more difficult. The education hitherto given to women in England is purely intellectual, and when a girl has passed the standard she at once goes into the ranks of the unskilled. If she can give time she may be apprenticed and learn a trade, but the number of girls who can afford to do that is getting fewer every day. The few shillings a girl can earn at once is too important an addition to the family income to be rejected, and as the majority of them marry while practically children, neither the necessity of being apprenticed nor of joining a union appeals to them.—*English Illustrated Magazine.*

A French syndicate has made an offer to the Turkish authorities to build a bridge across the Bosphorus, between Roumeli and Anatoli Hissar. The bridge is to consist of a single span 2,600 feet long, and with a clear headway of 230 feet.

There is in this city a young man who, although quiet and modest, is possessed of considerable genius. He and his charmingly agreeable wife keep house in a manner which might well be envied by any one. In order to make their house more comfortable for them on arising in the mornings, he has contrived an attachment to his heater which opens the lower door and closes the draught in the furnace door at any time in the morning which he may desire. This novel and useful apparatus is operated by means of an alarm clock, which is set at any hour he wishes to turn on the heat, and at the time the alarm strikes it releases a well-balanced lever, which drops a heavy weight controlling the entire arrangement. The alarm is generally set about an hour before they wish to arise, and thus the entire house is comfortably warm by the time they get about.—*Woodbury, N. J., Press.*

LETTERS FROM PRACTICAL MEN.

Fastening Rolling Machines to Asphalt Floor.

Editor American Machinist:

I notice that "Thick" has had some difficulty in fastening rolling machines to asphalt flooring. I think that difficulty can be overcome by driving stakes made of hard wood, say 8″ square and 18″ long, tapered at point, and then use wood screws.

JOHN CHISNEY.

Machine Foundations.

Editor American Machinist:

It is sometimes necessary, as has been found by "Thick," to set up machines on asphalt or ground floors, and there will be no trouble if the thing is done right. Some kind of foundation must be provided, masonry, of course, being the best, and for a very heavy machine indispensable; but in many cases heavy pieces of timber laid into the floor, and to which the machine will be fastened by wood screws, will answer every requirement.

The last machine that the writer had to put up on a ground floor was a bending roll weighing about 14,000 pounds, and about 10 feet long. The owner objecting to the expense of brick foundations, two pieces of 12″x12″ yellow pine, each 12′ long, were set into the floor, which was good solid earth; these pieces were well covered with pitch on three sides, and filled in all around with cement. The machine was bolted down to these, and never gave any trouble. The belts were two in number, 6″ wide, and pulled nearly vertically. With an asphalt floor it might be well to taper the timbers, making them say, 12″ wide on the bottom, and 10″ on the top, the trench in which they are laid to be 12″ wide on top, and 14″ at the bottom, the 1″ space to be filled with a good cement.

COMMON SENSE.

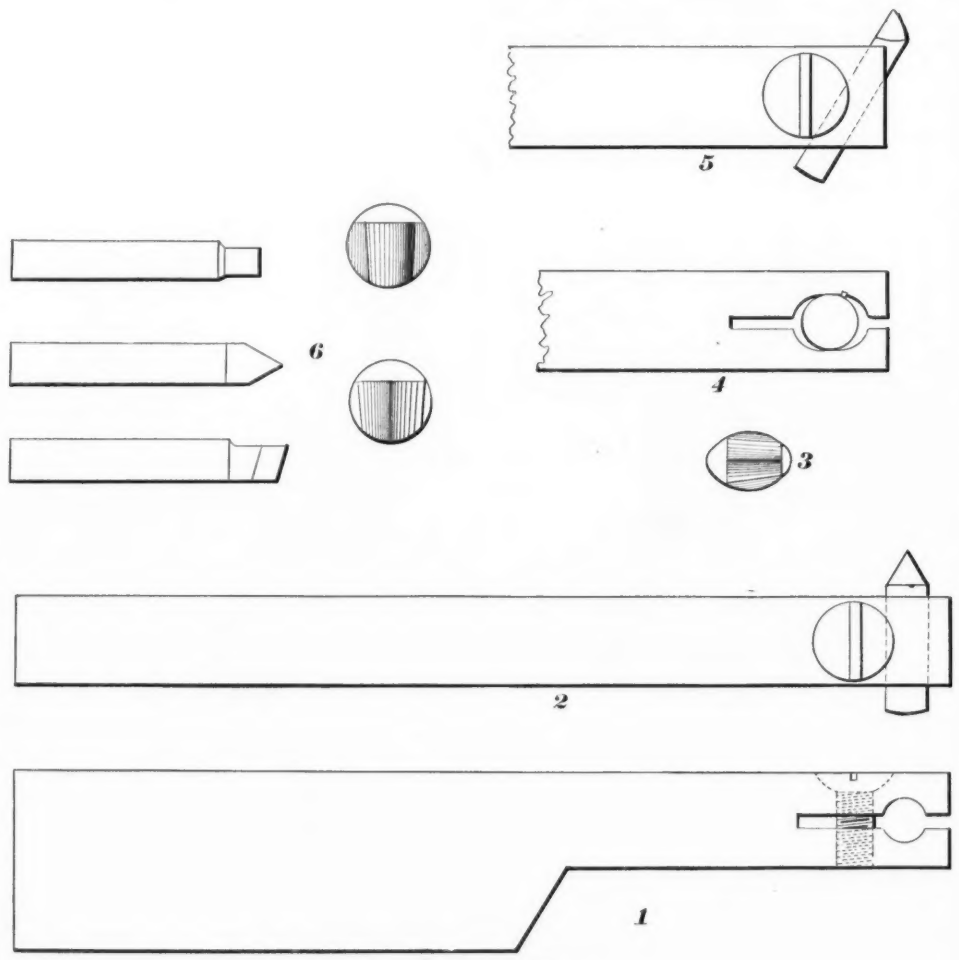
An Inside Thread Tool.

Editor American Machinist:

As the writer is always on the lookout for anything in the tool line—toolmakers' kinks, etc.,—he supposes others to be likewise We have outside threading tools by the dozen, some of them first-class too, that can be used with certainty and precision, but have never seen any genuine improvement on the solid forged *inside* tool for the same purpose, and, having that idea, began to wonder if it was impossible. Have made and used two or three substitutes, but had not found any specially good points except the saving of steel and forging—so devised the one here presented—whether any improvement or not the readers must decide.

It can't be used in very small holes, to be sure; but very few chase threads less than half inch, and one can be made for three-quarters that will stand any cut a tool lathe or any other ought to carry, though its size is unlimited, depending on the work to be performed. Fig. 1 gives a side view of tool, and with Fig. 2 to assist, a very complete idea can be formed, Fig. 1 showing the holder with clamping screw only, while in Fig. 2 the tool is shown in position.

The holder should be made of hard machinery steel of size convenient for work and tool post; and if intending to use round cutters as shown, the cut can be followed in making; by drilling the required sized hole for cutter (as near the end as considered safe for the strain to be put on it), and after drilling for set or clamp-screw, and tapping the lower half, a hack-saw cut will give all the spring required for clamping. A countersunk cone head screw is shown, as it was desired to make it as small as possible; and corners of the front end might be beveled off, making it a trifle smaller, as well as adding to the appearance. It may be desired to have a tool to chase in close to the bottom of some work, so for close work I propose something on the plan of Fig. 5, which will chase as close as anything can; it has two disadvantages, however, one that (for small work) it must be ground to the angle of sixty (or whatever the thread may be) *with* the holder, and next, that in replacing it, unless some mark is used it is difficult to replace it in exactly the same position, as a movement in or out advances or retards the point in its relative position to the threads. When I say "it must be ground with the holder," it is meant that the angle must be sixty or an equilateral triangle with the holder as a base. Some may object to round cutters, though they possess many advantages that seem to offset the objections—the holders are more easily made, as a round hole is less work than a square. The cutters are easily made of the regular commercial steel rods, only requiring to be shaped and hardened—though if Mushet's or any self-hardening steel can be obtained of suitable size it would obviate the hardening, and always be ready for use after grinding. The round cutters have the advantages of being readily turned to accommodate the pitch of the thread to be cut, doing away with giving the cutting point so much clearance when cutting sharp threads; this seems quite an item, as it leaves the cutting point better supported than otherwise; a slot across the back end serves to turn or adjust them.



INSIDE THREAD TOOL.

When the cutter hole stands square with the work, the cutter will always find its place *in the thread*, a slight difference in adjustment meaning only a difference in depth of cut. To obtain some positive method of holding in the same place every time without the tedious and not-to-be-thought-of screw (*i. e.*, having a thread cut the whole length of cutter, and screwing in), the following method suggested itself. The hole to be tapped and cutter threaded as just described and condemned, and then a little filing fixes things.

After tapping the hole, file out the sides to the bottom of threads in the oval shape shown in Fig. 4, and treat the cutter the same way, so that it will just slip through the hole *sideways*, when a quarter turn places it in position, and locks it as firmly as though it was screwed all the way in, and can be adjusted precisely alike every time. These are the advantages of round cutters—do the square cutters show enough to overbalance them? It hardly seems so, though, of course, means can be devised for holding them with precision also. Fig. 6 shows a few views of round cutters, the end views being enlarged to better show their appearance. But this is not the only use to which this tool can be put—it can be used for boring as well as threading, and save steel as well as room on the tool board; for by having several cutters, those not in use can be kept sharpened in readiness to replace the active one as soon as dull, and so little or no time is lost in changing or sharpening tools.

By making a double ended cutter to slip in place it becomes a boring bar for sizing out holes in standard work, and, like boring tools, these can be kept on hand of various sizes, and at a very small cost.

To a toolmaker who always has such a variety of work, the saving in tool board room alone is something of an item, for none of us like our tools scattered, and the tool board is the handiest place for them all.

FRED H. COLVIN.

Emery Wheels vs. Grindstones.

Editor American Machinist:

In all the discussion of these two important shop tools, there has been one little item regarding the emery wheel that has not been brought out, and I have waited, expecting the emery wheel makers to come forward with it.

Emery wheels generally have soft or hard spots in them; we all know that; so does a grindstone. In taking ten emery wheels of the same grade of emery or corundum, seven of them will have soft or hard spots of varying sizes and quality, and the only way to discover their imperfections that the writer knows of is to put them into use and try them. If by accident we get the eighth or tenth wheel on first, we have a good wheel, but it generally happens the other way. A good wheel does not have to be trued up every day, but it is hard to get the good wheel on the start.

Then another thing that will demoralize a wheel is the mechanic that uses it. Almost ninety-nine times out of a hundred he shoves his tool up against its rapid-speed periphery with the same sixty-ton pressure that he does against the slow-running grindstone, or else gouges his tool at it in about the same manner a cowboy prods an unruly steer.

Since looking upon Professor Sweet's "rapid grindstone," I have been through several other shops, and have come to the conclusion that what is assured success in the Professor's shops is very liable to be failure elsewhere. But still, much good is to come from it. First, we will get rid of all the old worn-out grindstones; second, it will set the emery and corundum wheel men to thinking how to make wet tool grinding wheels of the same hardness all around, and free cutters for machine shop practice, and once they get to thinking it over, the perfect wheel will come. Then, also, educate the men who use them how to use them.

The suggestion made by *Ambitious* regarding a truing device, whereby the grinder need not be dismantled, is very good, too, and will help the emery wheel along very much.

W. S. ROGERS.

Blue Printing.

Editor American Machinist:

In No. 17 of your valued paper we find under "Questions and Answers" a reply numbered 156, and giving information about blue printing.

We would draw your attention to it that you have not stated what is probably the real cause of the complaint of your correspondent. The fine lines which he wants to see white on the blue print will not come out through using fresh paper, etc., as they appear blurred because the light strikes through the tracing cloth under the inked surface which forms the line; in other words, the thickness of the tracing cloth is more than the width of the line, and the diffused light

penetrates the cloth and reaches the prepared paper with but slight obstruction from the fine line. By exposing the print at a right angle to the sun the lines will show tolerably well, especially if the exposure be quick. By reversing the tracing, so that the inked side is next to the prepared paper, and then getting absolute contact, the fine lines would show white, but of course the drawing would be reversed.

KEUFFEL & ESSER CO.

New York.

[Our correspondents point out an important cause for blurring of light lines on blue prints. But the fact remains, as we have indicated in our answer, that better results are obtained by using fresh prepared paper, than by using paper which has been prepared for some time previous to its use.]

Paternalism at Krupp's Works.

Dr. Von Jodlbauer, a Bavarian, in a lecture at Munich, had this to say about methods of helping workmen at Krupp's works at Essen. Referring to the fact that forty years ago there were but 3,000 he continued:

"Steam machinery, the railways, the telegraph, and the modern mode of warfare, have altered all the conditions of life there since then. In the year 1883 there worked in the establishments of this one man 19,605 men. They had 13,083 children in the obligatory school years, and 32,693 other persons dependent on them for support. ..... In Krupp's works there were 65,381 persons. Most of them had immigrated to Essen. They lacked much that they had been accustomed to—schools, churches, hospitals, and the like. It is evident that such a condition of affairs must have evil results. The increase of Essen's population increased the price of land. The owners of the land grew rich. The workingmen's quarters were expensive, crowded and unwholesome. The lack of living room pushed the men into the saloons, which rose in number from three to seventy. The middlemen and money lenders were multiplied sixfold. The discontent swelled with the accumulation of debts. The increasing evils of the situation led to the reform. In 1854 Krupp introduced a death and illness fund. It cost the workingman 2 per cent. of his wages, and the factory paid the rest. The total annual number of illnesses is now 21,000; the amount of the insurance fund, $300,000.

"In 1854 Krupp also established a pension fund, which now amounts to $500,000. The annual pensions are about $25,000, and increase $7,500 every year. The workingman's contribution to the pension fund is 1 per cent. of his wages, to which the factory adds its share of the burden. The average monthly pension is $13 for the man himself and $7.25 for his widow.

"In 1867 the factory began negotiating life insurance policies for the workingmen. In 1882, 1,788 persons were insured for $675,000, that is, about $375 each. The cost of insurance was 80 cents for every $25.

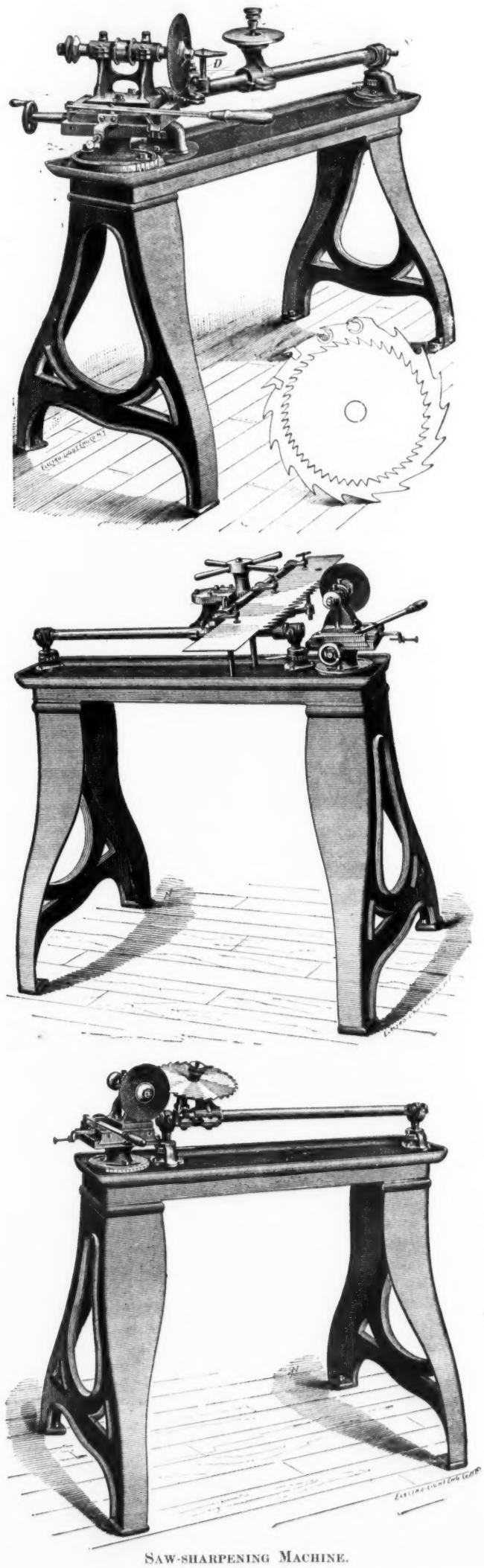
"The administration of all the funds was paid for by the factory, and was participated in by the workingmen. The Administrative Committee consists of a president and a member chosen by the factory, and four members chosen by the general convention. Refusal of an election to the committee is punishable with a fine of $2.50.

"As mentioned, the factory workingmen must pay 2 per cent. to the illness and death fund, 1 per cent. to the pension fund, and $3\frac{1}{8}$ per cent. for life insurance, if they wish to leave their families with a good income at their deaths. Beyond the 2 per cent., therefore, which the factory pays, the various funds absorb $6\frac{1}{8}$ per cent. of the workingman's annual wages, that is, about twenty-three days of his labor. ..... This burden is heavy. It is considerably lightened by the arrangement that he gets all the necessaries of life—like clothes, food, and house furniture, at low prices from the central distributing concern. This concern is conducted by the factory, buys in large quantities, and sells almost at cost for cash. It includes a bakery, a slaughter house, shoe, cloth and furniture warerooms, a coffee roasting machine with an enormous daily capacity, and a petroleum storehouse for seventy barrels.

"Krupp began erecting workingmen's houses at his own expense in 1863. After twenty years he had 3,208 houses, with 16,200 occupants. The tenants got gas at cost, and water for 37 cents per year. The rents return no profits on the invested capital, but only a low rate of interest. Krupp helps any employe who wishes to build and own a house. Since 1889 he has had a fund of $125,000, on which any of his workingmen, married and under 50, can draw for the purpose. The applicant must show that he has been three years in Krupp's service, and has an annual income of at least $750. He must pay $75 down and the rest of the loan in twenty-five annual installments, with 3 per cent. interest. The workingman must then live in his own house and own no other. ..... The cost of the preliminary work on the house and the plans are paid by Krupp.

"The public schools, with their twenty classes, get their rooms free from the factory. The factory also supports a private school with sixteen classes, and a housekeepers' school, with cheap dinners for motherless children, and five industrial schools with female instructors.

"The increasing size of the city, and the consequent competition for land and houses, results in neither higher rents nor notice to leave for the workingmen in the factory. The workingmen do not live in their own houses yet, but the acquirement of their houses has been rendered comparatively easy for them."



SAW-SHARPENING MACHINE.

Saw-sharpening Machine.

The fact that circular or straight saws driven by power cannot be expected to work in an entirely satisfactory manner and give the greatest efficiency unless all the teeth are precisely alike, and of the exact proper shape, has of course been universally recognized by the best and most experienced sawyers, as has also the further fact that it is by no means an easy matter to secure this condition by filing; and, in fact, it is seldom done in practice. Any irregularity of shape causing some teeth of a saw to do more work than others, causes an unequal strain of the saw, makes it deviate from a straight line, and prevents the best work being done, as well as limiting its quantity.

The machine which we herewith illustrate has been designed for the purpose of grinding the teeth of saws either circular or straight, and is so arranged that not only is absolute uniformity in the shape and height of the teeth of a saw secured for a given grinding, but this shape can be duplicated at any time and for every grinding until the saw is worn out. The machine is constructed and works upon much the same principle as the cutter grinders which have proven so indispensable to the successful operation of milling machines.

It consists of a bed-plate mounted upon substantial and heavy legs, and upon this bed-plate are two brackets which support a cylindrical bar, to which is fitted a bracket that supports the saw. This bracket can be clamped at any point on the bar, and can be placed at a sufficient distance from the emery wheel to enable a saw six feet in diameter to be ground. The bracket does not turn upon the bar, but is inclined to any angle desired, either way, by turning the bar in its supports, graduations being provided for this so that the angle may be noted and duplicated at future grindings. The bar is also adjustable vertically, so that the saw may always be brought level with the center of the wheel. The small circular plate upon which the saw rests has a conical hole in its center, projecting from which is a stud fitted with a conical collar and nut, the collar serving to center the saw accurately, so that its periphery will be true.

At one end of the bed-plate is the head which supports the emery wheel spindle. It swivels on the bed, and is graduated so that the slide upon which the wheel moves when grinding may be placed at any desired angle. There are two slides at right angles to each other, the lower one being used for adjustment of the wheel to position, and moved by a screw and hand-wheel, while the upper one is the one used in grinding, and is moved by the hand-lever to a stop which is adjustable. There is also a tooth gauge which is automatic in its action, and can be adjusted to suit any saw.

Where straight saws are to be ground there is an attachment provided for that purpose, as shown in one of the views. It bolts into place on the plate which holds circular saws, and consists of a slide operated by a rack and pinion, and pilot-wheel. The slide has a movement of 36 inches, and will therefore grind that length without changing the position of the saw. It may be inclined either way for any bevel required, and there are two adjustable perpendicular stays, which give ample rigidity.

One or two wheels may be used, as may be preferred, and wheels adapted to the work are furnished by the makers of the machine. A countershaft is furnished, which should turn at a speed of 600 revolutions per minute. Diameter of wheels used is eight inches, and the machine weighs 500 pounds. The makers are the Diebel Mfg. Co., Philadelphia.

AMERICAN MACHINIST

Communications relating to the reading columns should be addressed to the Editor. All other communications should be addressed:

AMERICAN MACHINIST,
96 FULTON ST., NEW YORK.

PUBLISHED WEEKLY AT
96 Fulton Street, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
J. G. A. MEYER, } Associates.
FRED J. MILLER, }

Special Announcements.

☞ Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.

☞ Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.

☞ We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.

☞ We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.

☞ Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.

Subscription.

$3.00 a year in advance, postage prepaid in the United States, Canada, and Mexico.
$4.00 a year to Other Countries, postage prepaid.

Advertising.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
The International News Company,
11 BOUVERIE STREET, Fleet Street, LONDON, ENG., will receive subscriptions for the AMERICAN MACHINIST, at 14/7 per annum, postage paid.

DEALERS SUPPLIED BY
The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
The Buffalo News Co., Buffalo, N. Y.
The Central News Company, Philadelphia, Pa.
The Cincinnati News Company, Cincinnati, Ohio.
The Cleveland News Company, Cleveland, Ohio.
The Colorado News Company, Denver, Colorado.
The Detroit News Company, Detroit, Mich.
The International News Company, New York, N. Y
The Minnesota News Company, St. Paul, Minn.
The Montreal News Company, Montreal, Canada.
The National News Company, New York, N. Y.
The Newark News Company, Newark, N. J.
The New England News Company, Boston, Mass.
The New Orleans News Company, New Orleans, La.
The New York News Company, New York, N. Y.
The Northern News Company, Troy, N. Y.
The Omaha News Company, Omaha, Neb.
The Pittsburgh News Company, Pittsburgh, Pa.
The Rhode Island News Company, Providence, R. I
The San Francisco News Co., San Francisco, Cal.
The South West News Company, Kansas City, Mo.
The St. Louis News Company, St. Louis, Mo.
The Toronto News Co., Toronto, Ontario, Canada.
The Toronto News Co., Clifton, Ontario, Canada.
The Union News Company, New York, N. Y.
The Washington News Company, Washington, D. C.
The Western News Company, Chicago, Ill.
The Williamsburgh News Co., Brooklyn, E. D., N. Y.

NEW YORK, MAY 8, 1890.

CONTENTS.

	PAGE.
The Accident to the City of Paris	1
Compound Locomotives. By W. H. Booth	2, 3
Self-oiling Countershaft and Pulleys	3
Odontics, or the Theory and Practice of the Teeth of Gears. By Geo. B. Grant	4, 5
Machine for Repairing Globe Valves	5
Woman and Wages	5
Letters from Practical Men: Fastening Rolling Machines to Asphalt Floor. By John Chisney—Machine Foundations. By Common Sense—An Inside Thread Tool. By Fred H. Colvin—Emery Wheels vs. Grindstones. By W. S. Rogers—Blue Printing. By Keuffel & Esser Co	6, 7
Paternalism at Krupp's Works	7
Saw-sharpening Machine	7
The Accident to the City of Paris	8
Put the Pipes in a Tunnel	8
The Bust of Holley Refused a Place in Central Park	8
Literary Notes	8
Questions and Answers	8, 9
Manufactures	9, 10
Engineering Progress and the Politicians	10
Immigration	10, 11
Work at Sibley College	11
A Plea for an Eight-hour Day	11
A New Gauge Cock	11
Low Water Alarm	11
Payment of Premiums for Continuous Service.	12
A Presentation	12
Machinists' Supplies and Iron	12

The Accident to the "City of Paris."

Seldom has anything occurred connected with engineering matters in which the public at large have taken so much interest as in the accident to the Inman & International Co's. most famous vessel. An equally serious breakdown, had it happened to almost any other steamship, would have excited far less interest, especially, if, as in this case, it had been unattended by loss of life. The very highest achievement in any line of human effort always possesses a peculiar interest, and the "City of Paris" enjoyed the distinction of representing the very highest and noblest example of marine architecture and engineering. She for the time being represented the limits of man's mastery over the seas, and that she should be, so early in her career and so completely, disabled at sea, was a great surprise and a severe disappointment. Nevertheless, we think, in view of all the facts which have been brought out, that it is one of the most fortunate accidents which ever occurred, and furthermore should serve to strengthen rather than weaken our confidence in the possible safety of ocean travel. For there is hardly a person at all acquainted with such matters, who would have believed that the "City of Paris," or any other vessel which could be made to float, would stand such an accident and yet land her passengers in safety. It is impossible for the mind to conceive of the pandemonium which must have reigned within that engine room for a few moments, nor of the tremendous forces exerting themselves to tear the vessel to pieces. A mass of iron and steel, standing forty-five feet high, and weighing upwards of a hundred tons, was in a twinkling reduced to a mere scrap heap; and, that the tremendous forces which accomplished this did not also send the vessel to the bottom, may be regarded as little short of a miracle, and certainly as a great triumph for her builders.

Accepting the theory of *Engineering* regarding the prime cause of the accident, as given in our quotation from its article, we are unable to see how any one can be blamed in the least for it. It seems to have been one of those accidents that could not have been foreseen, yet the recurrence of which may be prevented by the knowledge of this one. That the great wear and consequent dropping of the propeller shaft was due to some extraordinary or accidental cause, is sufficiently shown by the fact that the other one, which is precisely like it and has been subject to the same usage, remains in good shape. The fact that the bearing at which the trouble occurred is inaccessible to the engineers, except when the vessel is in dry dock, made it impossible for them to know its condition, as they surely would have done had it been otherwise. The fact that so much of the shaft must in the nature of things be inaccessible to the engineers in a twin-screw vessel must, we presume, be considered an objection to such vessels, and we do not see how it can well be avoided, though it might be possible to attach something which would show when any serious displacement of the shaft occurred. It must, we think, be concluded that the accident, with all its attendant circumstances and results, reflects credit upon the builders and owners of the ship, not the least creditable feature being the facilities which they have afforded to competent experts to make the fullest investigation of the matter, and give the results to the public. No such accident ever occurred before, and it is to be hoped will never occur again.

Put the Pipes in a Tunnel.

It is becoming more generally recognized every day that the plan of having tunnels under the principal streets of this city for all the pipes and wires, etc., is the only practicable solution of the difficulty which the city now labors under. This plan was proposed in these columns several years ago, and has since been referred to from time to time. The soil under the streets of the city is filled with a complicated network of pipes, big and little, carrying steam, water and gas, besides which there are electric subways, containing cables with wires conveying currents of all the different kinds known to electricians.

All these things are continually getting something wrong with them, and are perpetually needing repairs, which cannot be made without tearing up the pavement, digging down, and making holes and trenches in the street which are dangerous, and seriously obstruct traffic. All the various pipes and wires leak the various things which they are supposed to conduct, and the soil is permeated with gas, steam, water and electricity; combinations being frequently formed that result in subterranean explosions that make pedestrianism a dangerous occupation.

Then the gas men complain of all the other fellows, and say that no gas pipes can be kept tight that are continually being disturbed and undermined by diggers.

The electric companies complain of the steam heating companies' pipes, and say that the best insulation is rapidly destroyed by the intense heat to which it is constantly subjected by them. In short, each interest complains of all the others, and declares that if let alone by them things would be all right.

And it is evident that, in the nature of things, this must grow worse, for the tendency is constantly toward the more general distribution from central points, through conduits of some kind, of the things needed in the various buildings of a city.

Of course the matter can end in but one way—eventually subways *must* be provided, into which all these various pipes and wires can go, and large enough to allow of ready access for repairs, renewals or additions, without disturbing anything but the line worked upon. It would be expensive, of course, but there can be no reasonable doubt but that it would pay, taking all the benefits to all interested parties together. It might be a difficult matter to fairly apportion its cost between the various companies using it, but if the city should construct it and then charge the various companies a rental for its use, each in proportion to space occupied, and making its use compulsory after a certain time, due notice being given, there ought not to be any serious trouble. At any rate it is becoming more apparent every day that things cannot continue to go on as at present, and that subways must eventually be provided upon some plan.

The Bust of Holley Refused a Place in Central Park.

A bust of the late eminent engineer, Alexander Lyman Holley, has been executed, and it is, as a work of art, pronounced excellent by those competent to judge. But it has been decided by those in authority that it cannot be placed in Central Park. There is room in the park for statues of poets, of politicians, of authors, of warriors, of men whose careers have been made possible because such men as Holley have lived, but no room for the great engineer, who, more than any other man, was instrumental in planting in this country an industry—that of making steel—upon which industry literally millions of people live to-day; an industry that has done more than perhaps any other to place and keep this country amongst the foremost nations of the earth; an industry that has helped to girdle the country with railroads, and enables us to build our own war ships and great guns without assistance from abroad. There is, alas! no room for the bust of such a man as Holley in Central Park.

The fact that the bust of Holley is not to have a place in the park will not anger engineers. Amongst them his name will be known after the monuments there shall have crumbled to dust or shall have been disintegrated by the action of the elements. There will be amongst engineers nothing but a sense of shame that the greatest commercial and manufacturing city of the country fails to honor one of the greatest engineers of the country. A sense of shame that the decision that Holley's bust shall not have a place in the park is reached by men incompetent to understand who or what the man was, or to what extent his genius has influenced the condition and destiny of the country.

One of the leading dailies of New York puts forth as an argument against the placing of Holley's bust in the park that his "technical achievements would have to be explained to the great majority of visitors to the park." We venture the assertion that, as a whole, the majority of Americans who visit Central Park know as much of Holley's achievements as they do of the achievements of two-thirds of the men represented there by bust or statue. But if it were otherwise, and they were obliged to gain their information by inquiry, Holley's bust would serve the purpose of an excellent educator.

It is a positive shame and a disgrace to the city of New York that the bust of such a man as Holley shall not be accorded a place of honor.

Literary Notes.

The special number of *Engineering*, devoted to the Forth bridge, and to which we referred in our issue of March 20, has been reprinted and bound in book form for preservation. It makes an elegant, and, of course, very interesting volume, and one which every one interested in engineering or mechanical matters will find valuable. It is sold in this country by William H. Wiley, 53 East Tenth street, New York City, at $2.00 per copy.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(162) T. B., Montreal, asks: Will a 4-inch leather belt, single, drive eight horse-power, driving onto a 24-inch pulley running 174 revoluions per minute? *A.*—Such a belt should not carry over six horse-power.

(163) T———, S. C., asks: Can you tell me an easy way to find out what impurities are in feed water? *A.*—There is no easy way. The only way is to have a sample of the water analyzed by a chemist.

(164) C. L. B., ———, asks: Will you give me a rule, if there is one, for turning tapers on a lathe? *A.*—There is no rule which is exact, but you will find one which gives an approximation in the answer to Question 97, issue of February 27.

(165) R. C. T., ———, writes: In boring a taper hole in the lathe at an angle of, say, 25° or 30°, what is the effect of raising the tool above the center or (1) the angle of the hole and (2) the outline of the surface? *A.*—The correct place for the tool is at the center; supposing it to be there, the effect of raising it will be to lessen the angle and to make the sides of the bore curved instead of straight.

(166) D. S., Williamsport, Pa., asks: Please tell me what is the mixture of the brass known as best steam metal. Is it the same as that used for globe valves, etc.? *A.*—There is no standard mixture for that kind of metal. For brass castings subjected to steam pressure we should use twenty pounds of copper, one and a half pounds of tin, one pound of lead, and one pound of zinc; we should use the same for globe valves subjected to steam pressure. Some manufacturers use a cheaper mixture.

(167) M. T., Medina, N. Y., writes: One of my customers is using a 40 horse-power boiler, taking water from springs. The water is clear and apparently pure, but after running a few hours it looks milky, and a light fine substance, pure white, resembling magnesia, settles to the bottom in large quantities. From two to four pailsful are removed through the blow-off every half hour. It does not form any hard scale. Is there any means of removing sediment from the boiler, or would it be better to use a condenser and start with rain water? The boiler is run day and night. *A.*—We should advise the use of a feed-water purifier; with its use you need not start the boiler with rain water.

(168) R. T. D., Southington, Conn., writes: We have a heater which has been in use nine years; the tube head has commenced to leak This head is made of cast-iron, circular in form, and, in taking the heater apart, we

found that it had cracked through the central row of tubes. We intend to dispense with these flues, and plug up the holes with good rolled copper plugs screwed in; the cracked metal between the tubes we intend to drill out, and screw in plugs to meet the others through the flue holes. Is this method practical, or have you anything better to suggest? *A.*—We do not like the method; it is very doubtful if it will answer the purpose; and, if the head has a flange, you cannot stop the leak with the plugs. Probably the long usage of the heater has corroded other parts of the head. On the whole, we believe it to be better to put in a new head.

(169) G. R. F., Lawrence, Mass., asks: How much horse-power does it take to force 3 gallons of water per minute against 60 pounds boiler pressure? The work is to be done by two force pumps, piston type. *A.*—About .2 of a horse-power. 2. What should be the diameter of the cylinders, stroke, and number of revolutions? *A.*—For single acting pumps the diameter of the cylinder should be 1½ inch; stroke, 6 inches; number of revolutions, 50 per minute. 3. I want to take the power for these pumps from a shaft making 2,200 turns per minute; would a worm and gear work? Or what would be the best way to run the pumps? *A.*—On account of the great difference in speed of shaft and pumps we believe that the worm and wheel will be best for transmitting the power to the pumps; but, on account of the friction of the worm and wheel, the horse-power required to drive the pumps will be nearly double that given in answer 1.

(170) E. D. G., Philadelphia, Pa., writes: About a year ago we put a new fire-box into a vertical tubular boiler. The fire-box sheet has commenced to corrode on a level with the grate bars, and we believe it to be caused by the scale formed by the ashes which adhere to the side of fire-box. The bottom of the water space between the box and the shell is a solid steel ring. In order to overcome our difficulty we propose to cut off about eight inches of the fire-box, using the solid steel ring for the bottom of the water space as before, and place the boiler on a strong casting which contains the grate. Is this method practical? *A.*—No; because in placing the solid ring above the grate the portion of the furnace sheet which is covered by the ring will be burnt. We see no reason for the ashes adhering to the fire-box unless there is a moisture near it, and it seems to us that this can only be caused by a leak. If there is no leak we should advise you to line the box to a few inches above the grate with fire-clay.

(171) J. B. W., Sharon, Pa., writes: Please inform us how to line machinery, and also refer us to some reliable standard book on the subject. *A.*—We do not know of a book which treats entirely on this subject; indeed, your question covers, so to speak, a wide field, and includes many cases in which good judgment, independent thought and experience are required. Since many cases of lining up machinery are based on purely geometrical principles, and since the science of geometry develops the power of independent thought and reasoning, you will be much benefited by studying an elementary plane geometry, and, although it does not refer in the slightest degree to mechanical matters, you will become acquainted with principles and theories which cannot fail to help you in the various branches of the mechanical arts. 2. Are there any lectures delivered on scientific subjects? If so, what is the expense per lecture? *A.*—Your question is very indefinite. In large cities many scientific lectures are delivered; some of them are free, and for others the admission fee varies. Many of these lectures are published in book form, and these will probably serve your purpose better.

(172) G. F., Junction, N. J., writes: A coal storage depot is being built in this place, the machinery of which is run by a high-speed engine, geared so as to produce a much slower motion in the machinery. What advantage is there in such an arrangement? One of the men tells me it takes less steam. Does it? Please explain, and oblige a reader who is not a machinist, but is interested in machinery. *A.*—It is generally agreed among engineers that, in order to use steam in the most economical manner, it must be worked quickly, and particularly so when expanded three to five times, as in many automatic engines; and the shorter the stroke, the more quickly a given amount of expansion may be effected, and the less the loss by condensation. Hence the value of the high rotative speeds of engines lies in the fact that the time during which each charge of steam remains in the cylinder is reduced, and so, by lessening internal condensation, promotes, to an appreciable degree, economy of steam. The value of high rotative speeds lies also in the fact that it gives the piston speed required for obtaining the desired power from comparatively small short-stroke engines, thus contributing to economy of first cost and room required. Of course there is a limit of rotative speed; it is found in the considerations of construction, including design, material and workmanship, and of cost of subsequent maintenance.

(173) C. P. S., ———, writes: In looking over the Boston *Machinist* I saw an article about cutting gears which I cannot see into. I am only an apprentice, and therefore would like to learn all I can. This article says: "To find the size a certain gear should be for a certain number of teeth is an easy matter if you study carefully these rules: If you want a gear with 32 teeth and 8 to the inch, it would be 4″ across the diameter to the pitch line, and the $\frac{8}{8}$ would be $4\frac{8}{8}$″." Now I took a lathe gear with 48 teeth and 4 teeth to the inch, and, as I understand, you divide the number of teeth to the inch by the number in the whole gear, and by doing this for the lathe gear it would give you 12″ for the diameter, whereas, by measuring, it was only 4″ and a little over. Please explain. *A.*—You have made the mistake of supposing that "4 teeth to the inch" would mean 4 teeth to the inch of circumference, which is not what it means, but 4 teeth to the inch of diameter. Your lathe gear is what is called 12 pitch, *i. e.*, it has 12 teeth to the inch of diameter at the pitch line. Its pitch diameter is $48 \times \frac{1}{12}$, or 4″, to which is added twice the diametral pitch, or $\frac{2}{12} = \frac{1}{6}$, making its outside diameter $4\frac{1}{6}$″. 2. How large should the hole be for a 3″ shaft to be pressed in by hydraulic machinery? *A.*—it depends somewhat upon the nature of the job, but for ordinary conditions 2.997″ would be about right.

(174) J. F., ———, asks: What is the average consumption of coal per hour per horse-power, say, for engines with cylinders 10 or 12 inches diameter, boiler pressure under ordinary circumstances from 80 to 90 pounds? *A.*—The consumption of coal will depend on the type of engine, construction of the boiler, the draught, whether forced or natural, and the quality of the coal used. For ordinary non-condensing engines, which use steam with less economy than automatic cut-off engines, the following empirical rule may be employed for estimating the quantity of water to be evaporated per hour per horse-power: Divide the constant 350 by the square root of the pressure; the quotient will be the quantity of water in pounds per hour per indicated horse-power. If, for example, the pressure is 81 pounds, the square root of this pressure will be 9, and $\frac{350}{9} = 38.88$, say 40 pounds per hour per horse-power. If now the boiler can evaporate 8 pounds of water per pound of coal with natural draught there will be needed $\frac{40}{8} = 5$ pounds of coal per horse-power per hour. A good automatic cut-off engine will use about 25 per cent. less water than found by the foregoing rule.

(175) J. D. W., ———, writes: I see in an article by Isaac Whitehead, in the AMERICAN MACHINIST, entitled "Geometry Applied to Pattern Making," where he says: "To compute the true pitch [of a gear wheel] first divide 180° by the number of teeth, ascertain the sine of the quotient and multiply by the diameter of the wheel." I can find no rule with which to find the sine of the number of divisions. Can you give me a rule so I can find the pitch when the number of teeth and diameter are known, or vice versa? For instance, I have a wheel 40 inches diameter, containing 75 teeth. What is the true or chordal pitch? *A.*—The best and simplest rule for this that we know of is the one heretofore given in this column as follows:

$$P = \text{sine of } \left(\frac{180^\circ}{n}\right) D,$$

$$D = \frac{P}{\left(\frac{180^\circ}{n}\right) \text{ sine}},$$

where P = the pitch, D = the diameter at the pitch line, and n = the number of teeth. This is really the same rule given by Mr. Whitehead. You need no rule for finding the sine of the quotient of $180^\circ \div n$, but must look in a table of natural sines for it. Taking your example and applying the rule for finding the pitch, we first divide 180° by the number of teeth, which is 75; this gives us 2°24′. The sine of 2°24′, as given in the table of natural sines in Trautwine's Engineers' Pocket-book, is .0418757, and this multiplied by the diameter 40″ gives 1.675″, which is the true or chordal pitch. Now suppose a wheel is to be made with the same number of teeth, with a chordal pitch of 1.5″, its diameter will be found according to the second formula; thus: $180^\circ \div 75 = 2^\circ 24'$, and the pitch divided by the sine of this angle (.0418757) gives 35.82″ as the pitch diameter of the wheel.

(176) D. W. C., Philadelphia, Pa., writes: Please inform me what books I must get to commence the study of mechanics andgeometry. I cannot find any books on geometry in plain figures, and I do not understand algebra. *A.*—There are many good geometries in the market, and it is not fair to the authors of these for us to recommend any particular one, but we will say that we have used Davies' Legendre and E. Loomis' Geometry, but it must not be understood that other works are not as good. Probably the best way will be for you to procure the same geometry as is used in the public schools, and you may then have the advantage of the assistance of some of the scholars or teachers. It is not necessary to understand algebra in studying geometry, as good elementary geometries are written in very plain language, and the signs which are used are those which are used in a common arithmetic, and help to make the subject much plainer than if the ordinary language had been used throughout, in place of the signs. The study of geometry is not difficult; it is accessible to all, and is one of the most important branches of mathematics, as it lays, so to speak, the foundation for all other branches. Of course it requires an effort, close application to study, and a forced steadiness of thought. In the mind, as in the body, strenuous exercise alone can give strength and activity. The art of exact thought can be acquired only by the labor of close thinking. The foregoing relates also, and perhaps more so, to elementary mechanics. Many beginners often encounter difficulties, as the subject does not admit of an easy and familiar treatment, but it can be mastered by a degree of attention which the very nature of the subject requires. In selecting works on mechanics we should again advise you to be guided by the books used in the classes of the public schools. This subject should be taken up after the elements of geometry have been fairly mastered. A large portion of elementary mechanics can be studied without the knowledge of algebra; but, on the whole, we believe that fair acquaintance with elementary algebra will save time in the end.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Lexington Cut Iron Gears. See adv. on p. 16.

Link-Belting and Sprocket Wheels.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Engineering Co., Philadelphia and N.Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

"The Bulldozer," a new departure; forging by pressure. M'f'd by Williams, White & Co., Moline, Ill.

Pattern and Brand Letters. Vanderburgh, Wells & Co., 8 Spruce St., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Ice and Refrigerating Machines, 140 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Castings for small and medium-sized vertical engines. Humphrey's Foundry, Bellefontaine, Ohio.

Valve Seat Rotary Planing Machine. Pedrick & Ayer, Philadelphia, Pa.

Cylinder Boring and Facing Machines. Pedrick & Ayer, Philadelphia, Pa.

Light Special Machinery and Tools to order. The Meriden Machine Tool Co., Meriden, Conn.

Standard Tool Co.'s Twist Drills. S. A. Smith, 23 S. Canal st., Chicago, Western Representative.

Well-drilling Machinery and Tools. Williams Brothers, Ithaca, N. Y.

Audubon Machine Works, New Haven, Conn. Special machinery, heavy and light.

Steel Name Stamps, etc. Address W. G. Sackmann, 1099 First ave., Cleveland, O.

Get particulars of our new Wall, Suspended and Radial Drills. C. H. Baush & Sons, Holyoke, Mass.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Most sensitive and durable Damper Regulator made; works within one pound; send for circular. T. Kieley, 11 W. 13th st., New York.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See May 1, p. 14. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

S. W. Card & Co., Mansfield, Mass., make everything in the line of Taps and Dies. S. A. Smith, 23 S. Canal st., Chicago, Western Agent.

Patent Attorney. R. G. DuBois, 715 11th st., Washington, D. C., procures first-class patents on inventions. Valuable Hand-book on patents free.

Horton's Chucks. We offer the balance of our stock at 50 per cent. discount. McFadden Co., Philadelphia, Pa.

"Useful Hints on Steam." By E. E. Roberts. An illustrated book. By mail, 20 cents. W. Blitz, 18 Cortlandt st., Room 6, New York.

25″ 28″ 32″ 36″ Upright Drills a specialty. Finely made, great capacity, quickly operated, prices low. Send for list of firms using our Drills. J. E. Snyder, Worcester, Mass.

25″ 32″ 37″ 42″ "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, New Ark, N. J.

Patents.—Patent soliciting of high class. D. Walter Brown, 31 Nassau st., New York. Send for "A Brief History of Patent Legislation in the United States."

C. H. Redman & Co., Newark, N. J., Manufacturers of Light Machinery, Automatic Selling Machines, Telephone and Telegraph Instruments, Sewing Machine Attachments, Models, etc. Contracts solicited.

For Sale—Bound volumes of the Patent Office Gazette for years 1882, 1883, 1884, 1885, 1886, 1887 and 1888. Price, $4 per year. Address J. C., care of AMERICAN MACHINIST.

Every draftsman needs one. The Engineer's Sketch Book of mechanical movements, appliances, devices, contrivances, etc., by T. W. Barber. 1,936 illustrations. 8vo. cloth, $3. Catalogue of books on mech. subjects free. E. & F. N. Spon, 12 Cortlandt st., New York.

De Lamater Screw Propeller Wheel made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

Stub Ends and Connecting Rods for small connections. Especially adapted for Valve Rod for Steam Engines. T. C. Dill Machine Co., Philadelphia, Pa.

H. B. Roelker, 22 Cortlandt st., New York, late Sup't De Lamater Iron Works, will hereafter manufacture the De Lamater Screw Propeller. Propellors of same patterm and workmanship as formerly made by the De Lamater Iron Works. Each designed for its special work at lowest prices. Consulting Expert and Construction Engineer. Estimates made on machinery and on damages.

Just concluded. "Modern Locomotive Construction." By J. G. A. Meyer. The above series of 106 articles, which have attracted so much attention everywhere, is now concluded in newspaper form. Copies of the American Machinist containing the entire set sent by mail to any address in the U. S., Canada or Mexico for $5.30, or single copies 5 cents each. American Machinist Publishing Co., 96 Fulton st., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 53 East 10th st., New York.

"Binders" for the American Machinist. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton st., New York.

Just concluded. "Practical Drawing." By J. G. A. Meyer. Copies of the American Machinist containing the above series of 93 articles sent by mail to any address in the U. S., Canada or Mexico, for $4.65, or single copies 5 cents each. American Machinist Publishing Co., 96 Fulton st., New York.

MANUFACTURES

The city of Austin, Tex., will erect a dam to cost $1,500,000.

Henry J. Morgan contemplates starting a steam laundry in Brenham, Texas.

A company has been organized to build a $75,000 cotton mill at Washington, La.

Work is progressing rapidly on the Memphis & Charleston shops at Sheffield, Ala.

An addition, 50x75 feet, has been made to the Eagle Iron Works, Meadville, Pa.

Pfeiffer & Son are negotiating with a view to starting a piano factory in Brenham, Texas.

The Mousam Mills Company, Kennebunk, Me., will build a new engine house and put in a new engine.

The Howell Wheel Company, Covington, Ky. have let the contract for an addition to their works, 85x4000 feet.

The New York office of the Phœnix Iron Works Co. has been removed from 16 Dey street to 15 Cortlandt street.

A stock company has been organized at Salem, Va., to erect and operate a silk factory. The capital stock is $80,000.

Barrett Brothers, whose machine shop at Meadville, Pa., was recently destroyed by fire, will rebuild on an enlarged scale.

The Barrows Manufacturing Company has been incorporated at Rockland, Ill., to manufacture hardware. Capital, $50,000.

Huntington (W. Va) parties have just contracted for a large building at Iron Gate, Va., to be used as a foundry and machine shop.

There is a movement on foot among prominent business men of Houston, Texas, to erect a big cotton mill there in the course of a few months.

It is stated that a site has been selected at Salem, Va., for a steel plant. The McCarty basic process will be used, and the plant will cost $552,000.

Godwin Bros. have purchased buildings at Eufaula, Ala, and will put in machinery for making furniture, sash, doors and blinds, and woodwork.

William Frech, of Chicago, is erecting a machine shop and foundry at Streator Ill., for making punching machinery, machine tools and patented articles.

The West Superior Iron and Steel Co., of West Superior, Wis., propose to build a Bessemer works and a rolling mill for steel plates, beams and structural shapes.

A car manufacturing plant will soon be built at Venice, Ill. Mr. T. C. Salveter, formerly with the

St. Charles Car Company, is the prime mover in this enterprise.

The Parkhill Manufacturing Company, Fitchburg, Mass., has contracted for laying the foundation for an addition to its Cleghorn mill. The extension will be 80x60 feet.

A meeting has been called at Rio Grande City, Texas, on the 25th, to raise a bonus of $75,000 for a railroad to be built along the Rio Grande from Laredo to Brownsville.

The Home Oil Co., Cleveland, Ohio, has been incorporated, with capital stock of $25,000, by W. J. B. Allen, W. P. Champney, Wm. Austin, Geo. B. Shepard and Chas. Ruprecht.

Lexington, Ky., has raised nearly $50,000 for the purpose of bringing to that city the Enterprise Foundry, of Mt. Sterling, Ky. The works would give employment to about 100 men.

The Rouse-Duryea Company, of Peoria, Ill., has been incorporated, with a capital of $60,000, to manufacture bycycles and tricycles. H. G. Rouse, T. S. Beavis and L. B. Beavis are the incorporators.

The Baker Chain and Wagon Iron Manufacturing Company, of Allegheny, Pa., has a contract for 140 tons of naval chains for the Government, which is thought the largest order for chain ever sent to that city.

The Worcester Machine Screw Company, Worcester, Mass., has issued a new catalogue and price list of iron, steel and brass machine screws, studs, machinists' taps, nuts, etc. The illustrations are very complete.

The Yerkes & Finan Wood-working Machine Company has been incorporated, to operate at St. Louis, Mo. The officers are: President, John Yerkes; vice-president, P. A. Finan; secretary and treasurer, Charles Heflinger.

The city council of Waterloo, Ia., has passed a resolution exempting the plants of all manufacturing companies of a capital stock of $20,000 which may be organized in the future from all municipal taxes for a period of ten years.

The Stiles & Parker Press Co., Middletown, Conn., have issued a new illustrated catalogue of power punching presses. The catalogue is finely illustrated, and contains descriptions of presses, with instructions for setting up and operating.

The Wyoming Mills, Fall River, Mass., have been incorporated, for the manufacture of carpet warps, twines, ropes, or other articles from cotton and cotton waste. Capital, $100,000. C. C. Rounceville, president; William W. Howland, treasurer.

E. P. Bullard has discontinued his store in New York, having sold his entire stock of machinery and tools to J. J. McCabe. Mr. Bullard will hereafter give his entire attention to the manufacture of machine tools at his shops in Bridgeport, Conn.

The works of the Detroit Steel and Spring Company, which recently suspended payment, will not be closed for the present, a compromise with the creditors having been effected. The plant is a large one, its annual output being estimated at $1,000,000.

There is water-works agitation at Reidsville, N. C.; Tennille, Ga.; Florence, Ala.; Antigo, Wis.; Camden, N. J.; Paris, Ky.; Trenton, Tenn.; Rochester, Pa.; Gainesville, Ga.; Canton, Ohio; St. Thomas, Ont.; Muskegon, Mich.; Marysville, Cal.; Redding, Cal.

The American Arms Company, of Boston, it is reported, has been sold to go to Bluffton, Ala., and will be reorganized under the Alabama law, with a capital of $200,000. The business will be moved as soon as the necessary buildings at Bluffton shall have been completed.

John Maslin & Son, Jersey City, N. J., have furnished the Pennsylvania Railroad Company with their Pulsator steam pumps to remove the water from the excavations made in elevating the track in Jersey City. The Pennsylvania Company have eight of these pumps in use.

The local papers of Rockford, Ill., announce that a syndicate of capitalists there have effected an arrangement by which a branch foundry of the Cleveland Gas Stove Company, of Cleveland, Ohio, will be erected there. Work on the new buildings is to be commenced at once.

The Slatington Rolling Mill Co. has been organized, with a capital stock of $100,000, for the purpose of erecting a rolling mill at Slatington, Pa. The directors are Joel Neff, Fred Horlacher, David Williams, Hugh L. Davis, A. P. Steckel, Hon. D. D. Roper and John W. Hopkins.

The Rushville (Neb.) Manufacturing Company has been incorporated, for the manufacture of the Crosby wind engine and water conveyor. The incorporators are M. P. Musser, H. O. Morse, C. H. Meservey, F. M. Godfrey, J. K. Wahlford, L. J. Heath, H. C. Dale, A. D. Crosby.

The Swedish Porcelain Stove and Mantel Works, of Minneapolis, Minn., has completed its organization, with a capital stock of $100,000. A. E. Rice is president of the new corporation; Marcus Johnson, vice-president; Peter Johnson, secretary; H. S. Brandt, treasurer; and John Brandt, general manager.

The Pneumatic Railroad and Town Gate Company, of Chicago, has decided to move its entire plant and manufacturing business to Jenisonville, Mich., a suburban town eight miles down the river from Grand Rapids. Several local capitalists have taken stock in the company, which has been reorganized, with a capital of $300,000.

J. J. McCabe having purchased the business of E. P. Bullard's New York machinery warerooms, has moved the entire stock to his new building, No. 68 Cortlandt st., New York. Mr. McCabe had been connected with E. P. Bullard for thirteen years, and proposes to continue the business of dealing in all kinds of new and second-hand machinery.

Crossley Bros., woolen manufacturers, at Lowell, Mass., are having plans made for a new mill at Barre, where they own a privilege, as well as a large number of tenements, real estate, etc. The new mill will be 300 by 65 feet, two stories, with a picker building, 100 by 50 feet. They intend to have the buildings ready for the machinery by September 1.

The citizens of Plymouth, Mass., have voted a $40,000 subscription to the capital stock of the Plymouth & Middleboro Railroad. The road will be independent of the Old Colony corporation, and may be leased by the New York & New England. F. P. Prince, of Boston, agreed to furnish $160,000 of the capital stock of $300,000. The road will be sixteen miles long.

A Middlesborough (Ky.) dispatch says that the Pullman Street Car Company has closed a contract with the Middlesborough Town Company, by which immense steel car works will be erected at Middlesborough at once. The Town Company grants 45 acres of ground for the works, and subscribes for $200,000 of the company's stock. The company will employ about 2,000 men.

The Garvin Machine Co., New York, has issued a new catalogue of machine tools and fixtures made at the works. The catalogue is well illustrated, and contains descriptions of machines and their uses. It also contains tables and other useful information. Considerable space is given to illustrating and describing the operation of the milling machine, of which the firm make a large variety.

The Wisconsin Southern Railroad Company has filed articles of organization. It proposes to construct a road from Shullsburgh, where the Milwaukee & St. Paul has a terminus, thirty miles west to Rutledge, on the Mississippi River, in Grant County. The capital stock is $1,000,000, and the incorporators are Thomas Whitney, Crofts W. Higgins, Frederick K. Bowes, William Glenn and Henry L. Lee, all of Chicago.

The Ronceverte Milling and Manufacturing Company has been incorporated under the West Virginia law, with authorized capital of $300,000, of which $50,000 have been issued and taken up. The company has bought over 800 town lots, and a number of manufacturing sites situated between the Chesapeake & Ohio Railway and the Greenbrier River, and will make arrangements with any manu factories desiring to locate.

The Wilson Manufacturing Company, of Hamilton, Ont. (limited), has been incorporated under the Ontario Joint Stock Companies' Act, with a capital stock of $30,000, divided into $100 shares. The incorporators are Matthew Wilson, J. W. Auld, F. M. Wilson, John Wilson, of Hamilton, and Robert Auld, of Warwick. The company will manufacture agricultural implements at the corner of Cannon and Ashley streets in this city.

The Shreveport (La.) Improvement and Investment Company has been organized, the capital being $1,000,000, of 10,000 shares at $100 each, ten per cent. to be paid at the time of subscribing, and two per cent. thereafter, payable monthly. The object of the company is to built factories on the co-operative plan. The company is authorized to begin operations when $100,000 shall have been subscribed, and most of the stock has already been taken.

We have received the following from Eynon & Ingersoll, Cleveland, Ohio, which will explain itself: "The partnership heretofore existing between the undersigned, under the name of Eynon & Ingersoll, is this day dissolved. All the business of the late firm will be settled by Winthrop Ingersoll, who succeeds to and will continue the manufacture of milling machines, under the name of The Ingersoll Milling Machine Co., at the corner of Kirtland and Lake streets."

The Nova Scotia Steel and Forge Company, of New Glasgow, N. S., has been merged into the Nova Scotia Steel and Iron Company, with a capital of $2,000,000, and a debenture capital of $600,000. The company has been formed for the purpose of extending the present business, and assuming the franchises and other properties of the New Glasgow Iron, Coal and Railway Company, and to erect blast furnaces and manufacture iron and steel. Frank Ross, of Quebec, is a director.

The Albany Steam Trap Company, Albany, N. Y., has issued one of the very best catalogues of water filters we have ever seen. Not only are filters for large or small quantities of water well illustrated, but the text in the way of explanation is remarkably clear. Under the heading of "Water," several pages are devoted to giving general information about water, as good in its way as anything we have ever seen. Every engineer and mechanic ought to have a copy of this catalogue for the useful information it contains.

The Newark (N. J.) Electric Light and Power Company, which has been looking for property on which to enlarge their plant, has united with the Superheated Water Company, and secured the Poinier property on the Passaic River, between the city dock and the Preston Oil Works. It is understood that the Superheated Water Company intends to occupy a portion of the property also if it shall ever engage in business. The tract cost about $70,000, and the buildings, with a capacity for supplying 20,000 incandescent lights, will cost $100,000 more.—*Sentinel of Freedom.*

A deal was recently consummated by which three large nail mills and iron factories, the Waugh Nail Mill, of Belleville, Ill., the Valley Steel Works, of the same place, and the Tudor Iron Works, of East St. Louis, are consolidated under the name of the Valley Iron and Steel Works. The Western Nail Mill, of Belleville, is now controlled by the Valley Company, so that all four plants are, or will be, under one control. The capital of the new company is $450,000. Eight hundred men will be employed in East St. Louis, and seven hundred in Belleville. All the plants will be operated to their full capacity.

Mr. C. W. Sponsel, who occupies a responsible position in connection with the manufacture of the Hotchkiss rapid-fire gun at Pratt & Whitney's shops, has invented a new gun, which appears to possess some very excellent features. The breech-block contains complete within itself all the mechanism, and can be assembled complete, ready to be put in place, thus not only facilitating the manufacture, but making it practicable to have at hand duplicate breech-blocks, which can be applied to any gun quickly during an action. The mechanism is comparatively simple, enables a gun to be made very light in proportion to its length and caliber, and is practicable for guns ranging from 1 to 33 pounders.

The Nashua (N. H.) Land Company, recently organized, with a paid-up capital of $150,000, has elected officers as follows: President, George H. Knowles; vice-president, Harry G. Bixby; secretary and treasurer, George E. Gage; clerk and corporation counsel, George B. French. The company has purchased one hundred acres of land near Crown Hill, twenty acres of which is on the line of the Boston & Lowell Division of the Boston & Maine Railroad. It has also purchased Williams' iron foundry, which has a side track from the same road. The officers of the company say that contracts have been made with three manufacturing companies that are to be located on the land purchased, which will employ more than 1,200 hands.

The *Troy Press* has the following: "Some time ago the Delaware & Hudson Railroad Company proposed to erect machine shops at Whitehall [N. Y.] The company required a strip of land north of the roundhouse, owned by S. T. Cook, and asked the people of Whitehall to purchase it. On Monday evening a number of citizens met at the law office of Potter & Lillie to consider the proposal, which is as follows: The company will erect a machine shop, 65x195 feet; a car shop, 45x105 feet; a freight house, 108x25 feet, and a boiler shop, 25x95 feet. These shops will employ about fifty skilled machinists. H. G. Young, second vice-president, has guaranteed that work will be begun twenty-four hours after the people have guaranteed $2,000, the amout that it will take to purchase the ground. Subscription being thought the best way out of the matter, a few business men of the place voluntarily contributed $1,500 toward the work. Only about $500 remains to be raised."

Engineering Progress and the Politicians.

Few people who know anything whatever of New York City, and are at the same time in their right senses, doubt that the city needs a better system of rapid transit, and much better and more enlarged means of communication with the shores lying to the east and west across the Sound and the Hudson river. It is not only apparent that such a need exists, but it must be evident to any one who gives the matter the least attention that these things are absolute necessities if the city is to continue to grow in size and commercial importance. This being the case, it would seem as though the only questions which should enter into the problem would be those which competent engineers can decide as to the practicability of furnishing what is needed, and those pertaining to the financial part of the undertaking. But, really, if these were the only questions entering into such matters, it is altogether likely that some, if not all of these improvements, would have been secured before this; for the other difficulties which must be met and overcome, and which have no proper connection with the subject whatever, are much more difficult of solution than the legitimate problems which are inevitably connected with every important engineering work.

There is a large body of men in the city, and at Albany, who are engaged in the game of politics. When any question of a public nature comes up, such as is presented in connection with a project for bridging or tunneling one of the rivers, or allowing an underground rapid transit railway to be built, these men do not consider the matter from the same standpoint as the ordinary citizen, but solely with reference to its effect upon the game they are playing. And what makes matters still worse is the fact that the game is not an honest one, and matters of importance are never decided by it upon their merits, and are usually not settled right at all until the people are stirred up to recognize their importance, to demand that what is needed shall be forthcoming, and that the game shall be suspended until it is secured.

It has been declared by competent engineers to be perfectly feasible to bridge the Hudson river with a bridge so high, and of such magnificent span as not to interfere with navigation in the least. There is an abundance of capital which would be invested in the enterprise at once if there were nothing but the legitimate engineering and financial questions to be settled. But no sooner is such a proposition made than it becomes a part of the great game played by men who have no more interest in, and but little more knowledge of engineering matters and of the commercial needs of New York City than have the Hottentots. Their first and last thought in connection with every such matter is concerning how the greatest amount of money or the greatest advantage for their side of the game can be secured by means of it; and other men who are earnestly trying to accomplish something in the line of human advancement are blackmailed and harassed until, in many instances, they give up in despair.

There can be little doubt but that a bridge will eventually be built across the Hudson; but a bill allowing it to be done, which has passed both branches of the legislature, is vigorously protested against on the ground that its backers are not prepared to, and, in fact, have no intention of building such a bridge, but that the bill is nothing more nor less than a move of the great game by which the politicians and heelers make their living without work. If this is not true, then it is almost certain that the opposition to the bill is of that character, and whichever way it is makes little difference so far as securing the bridge is concerned. That will not be done, we may rest assured, until every possible move in the game has been made. It is a pity that great engineering undertakings must wait for such paltry causes, and the man who will do the greatest service to the engineering profession, and to commerce, will be the one who invents a way of abolishing the political heeler and striker.

Immigration.

The AMERICAN MACHINIST has, on all proper occasions, taken the ground that the promiscuous influx of immigrants to this country was an evil that would sooner or later manifest itself. The wise men of the country are just beginning to see this. It is at last dawning upon their minds that the class of immigrants who come here to remain a few years, living like barbarians, and then go to their homes to spend the money they have saved, are not entirely desirable. They crowd men out of work who were born here, or who have made this country their home, and who would continue to live and spend their money here like decent citizens.

The simple fact is, as we have before stated, that this country has grossly overdone the "asylum" part of the immigration business. While those who come here with the intention of making this country their home may always be safely welcomed, it should be borne in mind that, as against those who come here to get money—defying all laws of decency in doing it—to go back to Europe and live upon, the native-born American has some rights.

The people will—and justly—clamor against the rights of corporations and private employers of labor to import foreigners who know nothing and care less about the institutions of the country to take the place of citizens in the fields of labor. That this importation of laborers goes on in spite of the law to the contrary is a generally acknowledged fact. Congressman Owen, of the Congressional Sub-committee on Emigration, puts the number of those who come here in violation of the law at five hundred a week.

The manufacturers of the country are protected against competition of foreign manufacturers; the workingmen have at least an

equal right to demand protection against the competition of foreign labor that only aims to get money by means un-American, to spend in foreign countries.

Work at Sibley College.

Dr. Thurston, of Sibley College, Cornell University, writes as follows of the work of some of the young men there:

A number of Sibley College men have

INDICATOR CARDS SHOWING GOVERNOR ACTION.

been distinguishing themselves by patenting inventions that they think it possible may prove of advantage to them, and among the latest is a new form of shaft-governor for the Straight-line engine. Sibley College possesses the first of these engines ever built. It was constructed at Cornell University, in the Sibley College shops, by Professor Sweet when he was there in charge, and with the aid of students, about 1875–6. It was given a medal at the Centennial Exhibition of 1876, and has been since preserved as a souvenir of those days, as well as a reserve when needed to supply power.

During the last year Mr. E. S. Bowen, in the course of his work in the drawing rooms, designed a practically frictionless governor, which, assisted by Mr. Mount, he has now constructed and applied to the Straight-line engine. The accompanying cards show how well it distributes the steam. Its regulation is very satisfactory, and as close as the patience and skill of the engineer may make it.

These cards were taken with a new indicator, and, as seen, at all loads from maximum to a minimum of engine friction. The engine is 6″ by 12″, and the speed 275 revolutions per minute. The steam was carried at ninety-five pounds. The maximum load is about twenty I. H. P.; the minimum about one and a half. Mr. Bowen, who graduates this year, goes to Auburn, to the establishment of Messrs. McIntosh & Seymour, to get some experience building compound engines.

A Plea for an Eight-hour Day.

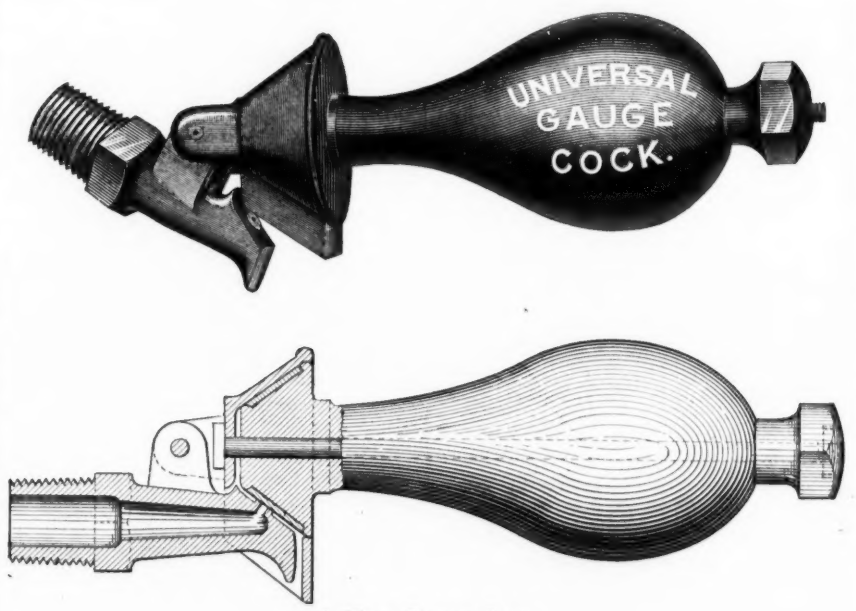
The Rev. John L. Scudder, a well-known Jersey City preacher, had this to say in the Tabernacle recently:

"In the early part of this century it was not an uncommon occurrence for the laborer to work fourteen hours a day. With the development of machinery, however, accompanied by the increasing intelligence and humanizing influences of our age, these tiresome hours have gradually been reduced, until to-day there is a very general demand, both in this country and across the water, for a work-day of eight hours. We are fast approaching the ideal division of the twenty-four-hour day—eight hours for sleep, eight hours for work, and eight hours for domestic and social life. This is the goal towards which society should advance as rapidly as possible. I believe, as a nation, we are too much devoted to business, and fail to give sufficient time to rest and recreation. This is true of the merchant, the editor, and professional man generally, as well as others. Eight hours of right down hard work is enough for any man or woman, whether the labor be of brain or brawn. What a happy people we would be if this rule applied to everybody in the land. The struggle for eight hours by manual laborers will be the first to reach the goal, which is very proper, for physical toil is most uninviting and fatiguing.

"The first great benefit coming to the laborer from a work-day of eight hours would be the improvement of his family life, and the enlarged opportunity for mental culture. The man who is compelled to leave his home at 6 o'clock in the morning, and does not see it again until 7 in the evening, is almost a stranger in his own house, and is too wearied to indulge in much mental exertion. Now, I claim that two hours less of labor, and two hours more of leisure, other things being equal, would make quite a change in his life and aspirations. He would have more time to enjoy his family and to cultivate his intellect, and larger opportunities for self-improvement. The common argument against increasing the leisure of the laborer, namely, that he will spend the time in dissipation, and had, therefore, better be at work, is invalid and misleading. The history of labor shows conclusively that drunkenness decreases as the hours of labor become fewer. Since the hours of labor have been reduced in England there has been improvement in the intelligence and character of laboring classes, and less drunkenness. Fatigue is an incentive to drink. The more fatigued the man becomes, the greater the incentive to drink. When a man is tired out, a glass of whisky will make him feel strong. This is the general law. Consequently the less severe the labor the less will be the drunkenness. It is in the interest of morality and religion, then, that humanity's work-day should be reduced to eight hours. Another good result will be the employment of a great multitude of idle hands seeking work, but unable to find it. Excessive labor leads to great mental depression—another cause of drunkenness. The happiest and the healthiest man, and the man most free from temptation, is the one who enjoys a proper mixture of labor and recreation. Between labor-saving machinery and unrestricted immigration, the honest laborer often finds himself a beggar. If the work-day in America was reduced from ten to eight hours, and the same amount of business were transacted, there would be an immediate demand for more laborers. Such a change would involve the readjustment of wages, a question for both labor and capital to determine. This reduction of hours of toil must come through intelligent discussion, and not by indiscriminate strikes, accompanied by a clamor for higher wages. Fanaticism and riot retard the progress of the laboring classes, whereas a calm and dignified agitation of these great questions never fails to do good. The world is moving in the direction of less toil and multiplied opportunities for the laboring classes. Every one who loves his fellow man is interested in this movement, and will rejoice to see its ultimate consummation."

A New Gauge Cock.

The simplicity of construction of the gauge cock shown in our illustration will be appreciated by engineers and those who are connected with the management of steam boilers. The section of the gauge cock shows the construction very plainly and will be readily understood. It may be said that it simply consists of a stem screwed into the boiler sheet, and a handle by which the flow of steam or water through the stem is controlled. The handle works on a pivot attached to the stem. The end of the handle is conical in form, and is covered with soft metal, which forms a packing. This packing is firmly held in place between the conical end and hood by means of the bolt which passes through the handle. A small portion of the hood is cut out, so as to allow the face around the small opening drilled through the end of stem to come in contact with the packing. The handle, which is either of cast-iron or wood, is necessarily made comparatively large, to obtain a sufficient amount of weight for holding the packing against the face on the stem. To open the cock, it is only necessary to lift the handle. When the packing becomes too much indented or worn over the opening, it is only necessary to slacken the nut at the end of the handle and turn it slightly around the bolt, thereby bringing into play an unused portion of the packing,



A NEW GAUGE COCK.

and thus forming a new seat over the opening in the stem. This operation may be repeated from 25 to 30 times, and can be done under the full pressure of steam. When the packing becomes completely worn out it can be very quickly and easily removed, and a new packing put in its place.

On account of its simplicity of construction, it is not liable to get out of order; its easy adjustment will be appreciated; it is cheap and durable.

This gauge cock is manufactured by the Universal Gauge Cock Co., Lancaster, Pa.

Low Water Alarm.

The accompanying illustration is of a low water alarm for boilers, which, we believe, possesses some valuable features tending to secure reliability and certainty of action.

Tapped into the top of the boiler is a pipe fitting having two openings, as shown, the outside thread which fits the boiler being the standard 1¼″ pipe size. Into the lower part of this fitting is screwed a length of pipe which is just long enough to reach to the lowest point to which it is desired the water level shall fall. Above this, and forming a continuation of it, is a copper pipe having its upper end closed by a plug, which is directly under the point of a set-screw which is fixed into the short horizontal arm of a lever, and is adjustable in it by a check-nut.

The longer vertical arm of this lever rests upon the extremity of another lever, which is pivoted upon a collar fastened to the pipe leading to the whistle. The other end of this lever supports a weight, which is attached by a chain to the whistle valve lever.

When in use the pipe leading to the whistle is filled with steam at all times, and cords can be attached to the lever so that the whistle may be used for signaling without disturbing the alarm mechanism.

So long as the water level is kept above the lower end of the pipe below, it, and the copper pipe above, will be filled with water, which, as there will be little or no circulation there, will be comparatively cold. But as soon as the water falls below the end of the pipe, the water in the pipe, of course, flows out, and is replaced by steam at a much higher temperature. The copper pipe expands, forces the short arm of the lever upwards, disengages its long arm from the other lever, allowing the weight to drop off and jerk the whistle valve open, holding it open until some one gives the matter attention.

The lever above the copper tube and the plug in the top of this tube are arranged so that they may easily be removed and a swab shoved down straight through the pipe to the water line, thus insuring an unobstructed passage and clean internal surfaces fully exposed to the heat of the steam, should it enter, while the clear condition of the other pipe can be tested at any time by simply pulling the whistle lever.

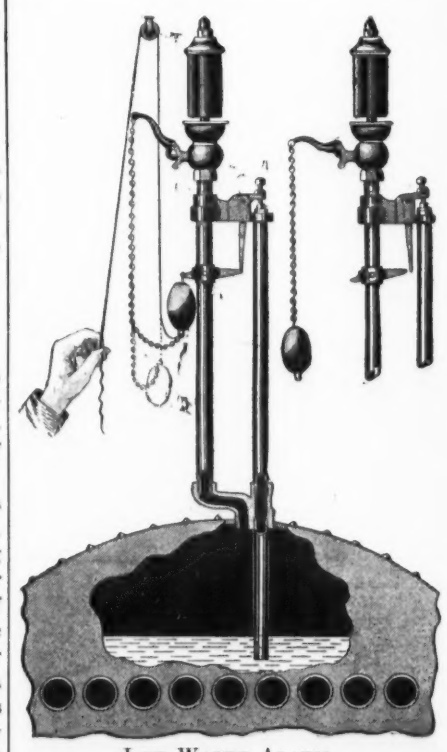
An expansion of less than one-hundredth inch of the copper pipe is sufficient to disengage the levers and cause the whistle to blow.

It is made complete, so that any engineer can attach it, by the Fox Machine Co., Grand Rapids, Mich.

Railroad men are by no means inclined to give up the use of steel ties. They are said to be in very successful use on a section of the Chicago & Western Indiana road, and the Delaware & Hudson Canal Co. is about to make a test of them.

In Germany water pipes are being made of glass with asphalt covering, to prevent fracture. It is claimed that they give thorough protection against moisture in the ground, and against the action of acids and alkalies, and that they cannot be penetrated by gases. It is also believed that they will not become incrusted.

We suggest the following definitions: A fanatic—a man who is determined to do what we do not wish done. An egotist—a man who feels his own importance more



LOW WATER ALARM.

than he feels ours. A bigot—a man who is firm in a belief different from ours. A prejudiced man—one who is not convinced by our arguments.—*Louisville Western Recorder.*

Payment of Premiums for Continuous Service.

The Illinois Steel Co. have, after some investigation of various premium-paying plans, concluded to try at their Joliet Works a plan by which employes who have not at any time, nor in any way, left the company's service, who have not temporarily absented themselves without leave, who have not been discharged or suspended for cause, and who have neither struck nor quit by their own voluntary act for one year, will receive, in addition to their regular wages, 1 per cent. of their wages for the last 6 months of the year. For 1½ years of such continuous service 1½ per cent. of their wages for the last 6 months of the period; 2 years, 2 per cent. for the final six months, and so on, increasing by one-half of 1 per cent. for every 6 months, up to 5 years, after which 5 per cent. will be paid in addition to regular wages in quarterly payments, so long as such service continues.

No doubt the plan is a good one, and the company will have to pay under it no more than such service is well worth as compared with what it may receive in the absence of such incentive.

It is founded upon the sound business principle that a thing which is actually worth more to the purchaser than another thing can command a higher price, and we therefore see no reason why it should not prove satisfactory to all concerned, so long as no unfair advantage is taken of it, which, it is easy to see, might be done.

One of our contemporaries, which notices the plan at some length, denominates it profit sharing, which seems a misnomer, in view of the fact that the premiums are fixed regardless of profits or losses to the company.

We fail to see how the premiums constitute profit sharing any more than payment of regular wages is profit sharing.

Something like one year ago, the fore-and-aft screw ferryboat Bergen was put in service on the Hoboken ferry. We do not know what the absolute economy of this boat is, as compared with the company's side-wheel boats, but for comfort of passengers there is no comparison. The Bergen is not only much more roomy and comfortable, owing to the small space occupied by her machinery, but there is almost infinitely less shake and tremble to the boat. The three cylinders of her triple expansion engines give a very equal turning to the shaft, and a passenger can read his paper with comparative ease. The peculiar and exasperating shaking up which one gets on side-wheel ferryboats from lack of a balance wheel is almost entirely lacking on the Bergen. Whether it costs more or less to operate the Bergen, she is by far the most comfortable ferryboat on the North River.

A Philadelphia correspondent writes us as follows:

"At a recent meeting of the Franklin Institute, mention was made of a new process for the manufacture of tubing of small diameter.

It is the invention of Mr. Ellwood Ivins, of Philadelphia, who trusts to secrecy rather than a patent to protect his valuable discovery.

By his process any of the principal metals can be worked—his card of samples showing gold, silver, platinum, aluminium, copper, and one of tempered steel, some of which had a bore of $\frac{1}{100}$ of an inch—rather small for seamless tubing.

The inventor claims that tubes of any length can be made, making it a valuable help in many of the arts."

In a paper read before the Manchester (England) Association of Engineers by Mr. M. Longridge, member Ins. C. E. & c., the following advice to boiler owners is given:

1. Get your boilers designed for the work they have to do, and not made 7 ft. 6 in. by 30 ft., or 8 ft. by 28 ft. as the case may be, because it is the fashion to have boilers of these particular dimensions.

2. Do not stick to 6 ft. grates if a shorter length is required to burn the coal at the rate of from 16 lbs. to 21 lbs. per hour.

3. Reduce your draught as much as the nature of the coal and the smoke inspector will permit. Try and reduce it till the fire is hot enough to melt a piece of steel boiler plate.

4. Buy your coal dry and keep it dry. Weigh the ashes which come out of the furnaces as well as the coal that goes into them.

5. Be most careful to stop up air leaks in the brickwork, and between the brickwork and the boiler.

There is a discussion going on in the columns of the *New York Times* regarding the comparative merits and demerits of manganese bronze and aluminium bronze for screw propellers, the makers of the aluminium bronze claiming that the navy department is using the manganese bronze without knowing anything of its composition or value for screw propellers. On the other hand, the makers of the manganese bronze show their confidence in the alloy by offering, not only to submit specimens to the navy department for testing, but to bear the expense of the most elaborate and thorough tests. As tests are also asked for by the aluminium bronze people, we may feel reasonably certain that something will soon be known about these things.

The United States proposes to build a lighthouse on the Outer Diamond Shoal off Hatteras. It is proposed to erect a tower 150 feet in height. The sum proposed for the construction of this lighthouse is $500,000—a sum probably too small for the purpose. It is believed that an immense iron caisson will be built, towed to the location, and anchored upright, its lower end, of course, sinking in the sand. Then excavation will be carried on inside the caisson, which will cause it to sink until it rests on the solid rock. Then the caisson will be filled with concrete. On this will rest the tower. Rip-rack will be used to further protect the caisson.

A Swedish engineer, who has been a resident in Buenos Ayres for many years, publishes a warning in Swedish papers against emigrating to Argentina, where things are in a very unsatisfactory state, and where a large number of European engineers are already unable to find employment.

During the past winter steam heating of railway trains has become nearly universal on the main lines in Prussia. Steam is supplied from the locomotive, and is reduced to a pressure of 30 pounds in the pipes that pass under the cars.

It has been decided to have a grand trial of automatic railway brakes in South Australia, some time in September next. All particulars can be had by addressing Sec. Brakes Board, House of Assembly, Adelaide, Australia.

A Presentation.

Mr. W. H. Weightman, who has for the past two winters had charge of a class in steam engineering at the Young Men's Institute in this city, was, at the conclusion of the sessions for this winter, presented with a silver ice pitcher and the usual concomitants. Accompanying the present was a letter from the class, setting forth in the most unmistakable terms the respect in which he is held.

Mr. Weightman has made an unqualified success of teaching in the Institute, and will resume his teaching next fall.

Machinists' Supplies and Iron.

New York, May 3, 1890.

Iron—American Pig.—There has been no noteworthy change since our last report, though the market is, perhaps, slightly firmer, and Southern

The New Metal of the Present, no longer "The Metal of the Future."

Aluminium!

JUST READY.

ALUMINIUM.—Its History, Occurrence, Properties, Metallurgy and Applications, including its Alloys. By Joseph W. Richards, M.A., A.C., Instructor in Metallurgy at the Lehigh University. Second edition, revised and greatly enlarged. Illustrated by 28 engravings and two diagrams. 500 pages. 8vo.

Price $5.00, by mail, free of postage to any address in the World.

CONTENTS.—Chapter I. History of Aluminium. II. Occurrence of Aluminium in Nature. III. Physical Properties of Aluminium. IV. Chemical Properties of Aluminium. V. Properties and Preparation of Aluminium Compounds. VI. Preparation of Aluminium Compounds for Reduction. VII. The Manufacture of Sodium. VIII. The Reduction of Aluminium Compounds from the Standpoint of Thermal Chemistry. IX. Reduction of Aluminium Compounds by means of Potassium or Sodium. X. Reduction of Aluminium Compounds by means of Potassium or Sodium (Continued). XI. Reduction of Aluminium Compounds by the Use of Electricity. XII. Reduction of Aluminium Compounds by other means than Sodium or Electricity. XIII. Working in Aluminium. XIV. Alloys of Aluminium. XV. Aluminium-Copper Alloys. XVI. Aluminium-Iron Alloys. XVII. Analysis of Aluminium and Aluminium Alloys. Index.

☞ *A circular of 4 pages, 4to, showing the full Table of Contents of this thoroughly revised and recast treatise, showing the state of the industry up to 1890, and which has played an important part in the rapid development of this New Metal, will be sent free, and free of postage, to any one in any part of the world who will furnish his address.*

☞ *Our new and revised Catalogue of Practical and Scientific Books, 96 pages, 8vo, and our other Catalogues, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish us with his address.*

HENRY CAREY BAIRD & CO.,
Industrial Publishers, Booksellers & Importers
810 Walnut St., Philadelphia, Pa., U. S. A.

BRADLEY HAMMERS AND FORGES.

The BEST HAMMERS in the WORLD RUN BY BELT.

Over 1500 In Use.

Three Styles, 15lb. to 500 lb. Heads.

Our **FORGES** heat irons fast enough to keep Hammers and men fully employed.

Send for Catalogue and Prices.

BRADLEY & COMPANY, Syracuse, N. Y.
63 Murray St., NEW YORK. 93 Sudbury St., BOSTON.

JOHN WILEY & SONS, NEW YORK, Publish:

Wilson's Steam Boilers, 12mo, cloth,	$2.50
Thurston's Manual of Steam Boilers, 8vo, cloth,	6.00
Ford's Boiler Making, 18mo, cloth,	1.00
Thurston's Steam Boiler Explosions, 12mo, cloth,	1.50
Grimshaw Steam Engine Catechism, 18mo cloth,	1.00
" " " Vol. II, 18mo, cloth,	1.00
Whitham Steam Engine Design, 8vo, cloth,	6.00
Hemenway's Indicator Practice, 12mo, cloth,	2.00
Pray's Twenty Years With Indicator, 8vo, cloth, new edition,	2.50
Thurston's Engine and Boiler Trials,	5.00

MACHINERY For Reducing and Pointing Wire.

ESPECIALLY ADAPTED TO POINTING WIRE RODS AND WIRE FOR DRAWING.

For Machines or Information, address the Manufacturer,

S. W. GOODYEAR, Waterbury, Ct.

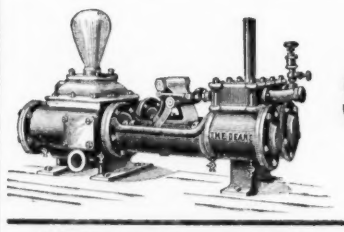
GEO. F. BLAKE MANF'G CO.

BUILDERS OF EVERY VARIETY OF

Pumping Machinery

95 & 97 LIBERTY ST., NEW YORK. 111 FEDERAL ST., BOSTON.

WATER WORKS PUMPING **ENGINES A SPECIALTY**

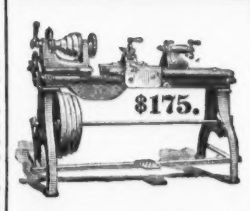


THE DEANE
OF HOLYOKE
STEAM PUMPS
DEANE STEAM PUMP CO.,
HOLYOKE, MASS.

BEST STEEL

For Taps, Dies, Punches, Milling Cutters, Lathe and Planer Tools, Cold Chisels, Edged Tools and Hardware of all kinds.

CRESCENT STEEL CO.,
136 FIRST AVE., PITTSBURGH, PA.
64 & 66 So. CLINTON ST., CHICAGO, ILLS.
430 PEARL STREET, NEW YORK, N. Y.



Improved Screw Cutting Foot and Power **LATHES**

Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.

THE SEBASTIAN-MAY CO., 167 W. 2d St.,
CINCINNATI, O.

MONTGOMERY & CO., 105 Fulton St., New York, Gen'l Agents.

TOBIN BRONZE

Tensile Strength upwards of 79,000 lbs. per sq. in.
Torsional Strength equal to the best Machinery Steel.
Anti-Frictional and Non-Corrosive.

CAN BE FORCED HOT.

Rods for pumps and bolts. Yacht shafting. Rolled sheets and plates for pump linings and condenser tube sheets, &c. Ingot metal for car and engine bearings. Spring wire.

ANSONIA BRASS & COPPER CO.,
Sole Manufacturers.
Send for Circular. CHICAGO. NEW YORK.

BETTS MACHINE CO., WILMINGTON, DEL.

MAKERS OF

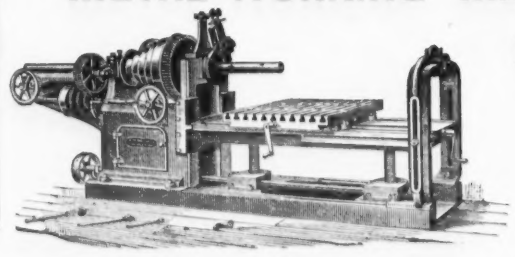
METAL-WORKING MACHINE TOOLS

FOR

Locomotive, Bridge & Engine Builders, Railroad, Car & Machine Shops

AND

Iron and Steel Works Generally.



producers seem a little less anxious to sell. The stocks of Northern furnaces have been somewhat reduced during the week, but the influence of the Southern furnaces seems to dominate the market, and consumers seem to be still inclined to cover their immediate wants in a conservative way.

We quote Northern brands No. 1 Foundry, $18 to $19; No. 2, $17 to $18. Southern brands No. 1, $16.75 to $17.50; No. 2, $16 to $16.50. But some orders have been placed at prices somewhat lower.

Scotch Pig—Lower prices have been established here in accordance with the general downward tendency.

We quote Eglinton, $18.50 to $19; Dalmellington, $21.25 to $21.50; Coltness, $24.50 to $25.

Bar—The demand has been moderate, with prices in buyers' favor.

We quote Common, $1.85; Medium, $1.90; Refined, $1.95 to $2, for round lots on dock.

Copper—There has been a large sale of old syndicate stock for forward delivery at 14½ cents, and this, with other transactions, has imparted a firmer tone, though prices are not quotably higher.

We quote Ingot, Cakes and Wire Bars at 14⅜c. to 14½c. Common casting brands are somewhat easier, at 12⅜c. to 12½c.

Lead—Supplies have been firmly held at the higher prices quoted last week, though consumers and dealers have remained indifferent, and the demand is quite moderate.

For prompt and near delivery prices are 4.02½c. to 4.05c. For future deliveries prices have ruled somewhat higher on the exchange.

Spelter—The market has been quiet and steady, with sales of car lots. Ordinary brands, at 4.95c. to 5c.; 5.05c. to 5.10c. for Prime, and 5⅜c. for Choice.

Silesian is higher, in consequence of advanced prices in London.

We quote Ordinary brands of Western, 4.95c. to 5.05c.; Choice, 5.35c. to 5⅜c.; Refined, 6¾c. to 7c.; Silesian, 6⅝c. to 6¾c.

Tin—The market has fluctuated sharply, due principally to speculative influences, chiefly on the other side.

Dealers' prices are 20.60c. to 20.70c., jobbing.

Antimony—The demand has been moderately active, but there has been little or no change in prices for Regulus.

We quote Hallett's, 18½c.; Cookson's, 25c.

Lard Oil—Prices have slightly declined, and sales have been made at 53c. to 53½c. for Prime.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—Competent machine shop foreman wants a change. Can turn out first-class work at lo vest cost. Address J. C. M., AMERICAN MACHINIST.

Wanted—A 1st class machinist familiar with arc dynamo construction. Address, stating exp., and salary wanted, Clark Electric Co., 192 B'way, N. Y.

Wanted—Two first-class instrument makers. Apply by letter to T. C. Mendenhall, Superintendent U. S. Coast and Geodetic Survey, Washington, D. C.

Wanted—Good general machinist to work on Corliss engines, ice and refrigerating machinery. Address Frick Company, Waynesboro, Franklin Co., Pa.

A competent mech. engineer wants a responsible and permanent position where very varied exp., especially in heavy machinery and in structural iron work, can be utilized. Box 841, Pittsburgh, Pa.

Machinists Wanted—First-class floor hands and fitters of large experience and of good habits can find steady employment and liberal wages. Address Morgan Engineering Company, Alliance, O.

Wanted—Good tool-room machinist on night force; five nights per week. Electric lights. Steady work Apply, with references, to The Westinghouse Machine Company, Pittsburgh, Pa.

Wanted—Competent sup't for machine tool shop of about 30 hands. State experience, reference, and expectations. Replies will be treated confidentially. Address Machine, AMERICAN MACHINIST.

Machinists Wanted—First-class hands, competent to undertake the erection of machine tools. Steady work and good wages to good men. Betts Machine Co., Wilmington, Del.

Draftsmen Wanted—Several draftsmen that are familiar with blast furnace and rolling mill works. Give references and terms. Address Gordon, Stroebel & Laureau, L'd, Philadelphia, Pa.

Wanted—A position as foreman by a first-class tool maker, machinist and draftsman. 2½ years as foreman in shop making the very finest of tools for interchangeable work. Age, 35 years; sober and industrious. Box 10, AMERICAN MACHINIST.

Wanted—Competent mech. draftsman familiar with punching mach'y and mach. tools. One who has some faculties for sup't will have a good chance for advance. State exp., and salary wanted. Must work himself up. W. Frech Machine Works, Streator, Ill.

Wanted—10 or 12 good machinists, principally vise hands. Only those familiar with the erecting of wood-working machinery need apply. This will be a good opening for ambitious young men. Address E. & B. Holmes, 59 Chicago st., Buffalo, N. Y.

Wanted—Machinists. Several first-class vise and lathe hands to work on punching machinery and machine tools. Steady job and good pay to first-class mechanics. W. Frech Machine Works, Streator, Ill.

Engineer well acquainted with designing and erecting of sugar machinery, vacuum machines, diffusion batteries, machinery for beet sugar generally, and with steam engineering, is open for engagement at July 1. Address Box 15, AMERICAN MACHINIST.

Foundry foreman with plenty of experience in making engine castings is wanted by a firm that will give a good position with a good salary to the right man. Address Engine Builders, AMERICAN MACHINIST.

Wanted—In one of the Middle States, a thoroughly competent designer on light machine tools and automatic machinery. Must be familiar with modern methods and shop practice. State positions held formerly, and give references. Address Box 7, AMERICAN MACHINIST.

Sup't wanted by a large manufacturing concern in a large center working iron and wood—chiefly the former. Must be a thoroughly educated mechanic and a draftsman, energetic, exp'd, and competent to handle large numbers of men. Give full exp., refs., and age. Box 6, AM. MACH.

Engineering Correspondent Wanted—Correspondent exp'd in heavy machinery, and capable of obtaining data on which to base orders, preparing proposals and submitting information to customers. Address, stating age. exp., refs., and compensation expected. Correspondent, Box 5, AM. MACHINIST.

Wanted—Position by a young man, American, 29, accustomed to universal milling machine work, cutter and reamer grinders, making of cutters, etc., machine tool repairs, gear and rack cutting; a fair draftsman. Steady work required. Address Box 12, AMERICAN MACHINIST.

Wanted—Position as sup't or foreman by a young man, 35, successful in the systematic manufacture of machinery and mechanical devices, and in the economical management of men. A draftsman and designer of automatic and interchageable machinery, tools, jigs, etc. Box 14, AMERICAN MACHINIST.

Wanted—1 first-class draftsman, 3 first-class pattern makers, 15 first-class machinists experienced on engine work, and 15 first-class moulders. No second-rate men wanted, as we manufacture only high-grade work. Good wages and steady work to the right men. Address Sioux City Engine Works, Sioux City, Iowa.

Wanted - A live man for sup't. Must be a practical machinist; one who knows how work should be done, and can manage men and machines successfully on piece-work basis. Work—agricultural engines and machines, and general work. State age, experience, and salary expected. Address Box C. Schenectady, N. Y.

A Shop Foreman—A foundry and machine shop employing about 200 men, located within 50 miles of Boston, is in need of a machine shop foreman who knows how to obtain first-class work from men and tools in the fewest possible hours. A man with some experience in printing presses preferred. Address "Webster," care AMERICAN MACHINIST.

Wanted—A foreman for the machine shop of a large iron works manufacturing screwing machines, pipe taps and dies, steam fittings, and doing a general gas works business. An excellent opportunity is offered to an active man, with plenty of snap and system, and having experience in these lines. State age, experience, and pay expected. Address Box 11, AMERICAN MACHINIST.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Cheap 2d-h'd Lathes & Drills. S. M. York, Clev'd, O.

Koopman's Scales for quick measurements.

Just out; aluminum-steel hack-saws, hard but not brittle. Crescent Mfg. Co., Cleveland, Ohio.

New catalogue of engineers' specialties free. Crescent Mfg. Co., Cleveland, Ohio.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

Turned and Highly Polished Iron and Steel Shafting a specialty. Merwin McKaig, Cumberland, Md.

Complete list of our Scales and other new tools for 2c. stamp. A. T. Koopman, Chicago.

Castings of every description and machinery built. Address Cedar Point Foundry, Port Henry, N. Y.

Wanted—Customers for our new Radial Drills. C. H. Baush & Sons, Holyoke, Mass.

Wanted—Machine firm to build and sell my automatic dynamos and motors. "Volt," AM. MACH.

Engineers wanted to send their addresses and receive free a 25 cent book, "Hints and Suggestions for Steam Users." Lord & Co., P. O. Box 1262, Phila., Pa.

Simonsen-Walter Mfg. Co., Jefferson City, Mo., with modern foundry, machine and wood-work plant, wants spec. to manuf. for Western trade.

Wanted—To buy second-hand lathes, planers and shapers of all sizes. Must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

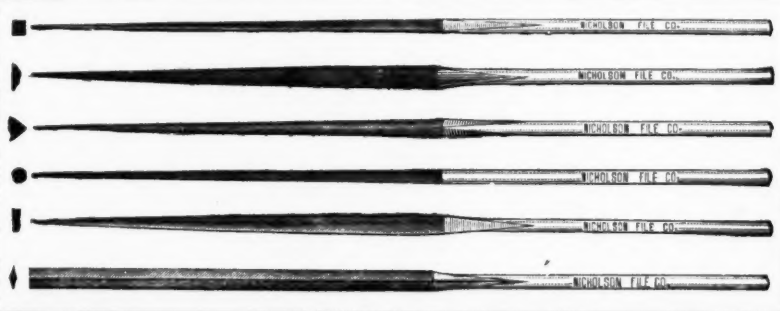
For Sale Foundry and Machine Shop with plenty of orders ahead, in Western town of 7,000 population—coal mining district. Will sell half interest to a good machinist. Address Box 9, AM. MACHINIST.

For Sale—Patent No. 424,360, dated March 25, 1890. This very true and simple shaft bearing can be constructed very cheaply, because it requires no lathe work. Any capitalist feeling interested may address the inventor, Hippolyte Schneider, 2109 Jane st., Pittsburgh, Pa.

For Sale—Half interest in an established, paying and growing machine shop and foundry business in town and county seat in southern Minn. Situated on two lines of railroad. This is the only shop in the county, and a rare chance for a man of small capital. Machinist pref'd. Waseca Iron Works, Waseca, Minn.

Wanted—Parties to manufacture, for sale, automatic cut-off steam engines for high or ordinary speeds, band, circular and auxiliary saw machines for lumbering plants; steam boiler furnaces with stokers, refuse burners, clutch pulley, bale tie, compound street rail; all new designs in scale drawings. Write for description to J. G. McCormick, 1000 W. Walnut st., Louisville, Ky.

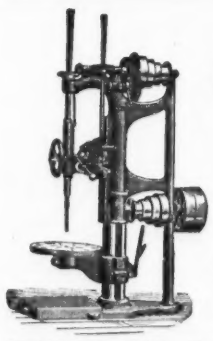
FILES and RASPS. PROVIDENCE, R. I., U. S. A.



MONEY FOR MANUFACTURERS

Any manufacturer desiring to change the location of his plant or establish a new one, will be given a fine site with unsurpassed advantages, and also advanced *a liberal amount of cash*, subject only to a satisfactory examination. This offer is bona fide, and only principals will be dealt with. Address

WEST LYNCHBURG LAND COMPANY,
LYNCHBURG, VIRGINIA.



FITCHBURG Machine Works,
Manufacturers of
METAL-WORKING MACHINES.
Office and Works,
13 to 21 Main Street,
FITCHBURG, MASS.
SEND FOR CATALOGUE (E.)

THE BRITISH & EUROPEAN PATENT AGENCY,
F. W. BARKER, Manager,
(Reg'd Eng. Pat. Agent.)
252 BROADWAY, NEW YORK.
European Patents obtained at low rates and sold on Commission through London House. *A good invention is worth as much in Great Britain as in the United States.* Competent draftsmen employed on the premises, and special terms allowed inventors also obtaining their U. S. patents through the Agency. (CORRESPONDENCE SOLICITED.)

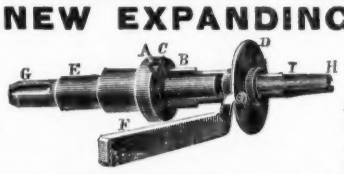
THE CELEBRATED
HEALD & SISCO
CENTRIFUGAL PUMPS
Vertical and Horizontal.
COOKE & CO.,
22 Cortlandt St., New York.

In Writing Mention this Paper.

WILLIAM JESSOP & SONS, L'D.
MANUFACTORY, SHEFFIELD, ENGLAND. | Chief American Office, 91 JOHN ST., NEW YORK
JESSOP'S BEST TOOL STEEL
Gold Medal, Paris, 1889.
Steel in Stock. ALL KINDS OF Importation Orders Promptly Filled.

NEW AND SECOND-HAND
MACHINERY
FOR IMMEDIATE DELIVERY.
One Fifield Lathe, 30'x16'. New.
One Lathe and Morse Lathe, 32"x15'. New.
One Blaisdell Lathe, 28", raised to swing 36" on 12' bed. In good order. Second-hand.
One Fifield Lathe, 38"x14'. New.
One Powell Planer, 30"x80"x8'. New.
One Powell Planer, 36"x36"x12', with 2 heads. New.
One L. W. Pond Planer, 44"x40"x12', with 2 heads. New.
One Slotting Machine, 16" stroke. Second-hand.
One Bement Steam Hammer, cylinder 16"x44", rated 3500 lbs. In fine condition.
Send for Complete List of New Tools.
HILL, CLARKE & CO.,
156 OLIVER STREET, BOSTON, MASS.

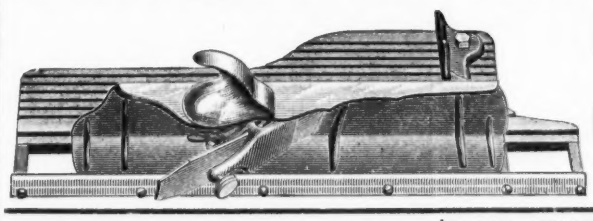
LECOUNT'S NEW EXPANDING MANDREL.
Amateur's Size. Machinist's Size.
Taking anything from ⅛ to 1 inch inclusive.
Price $5.00
Patented Dec. 25, 1877.



No.		Price.
1	½ to 1	in. $10
2	1 " 1½	" 14
3	1½ " 2	" 18
4 (with screws)	2 " 3	" 32
5 "	" 3 " 4	" 44

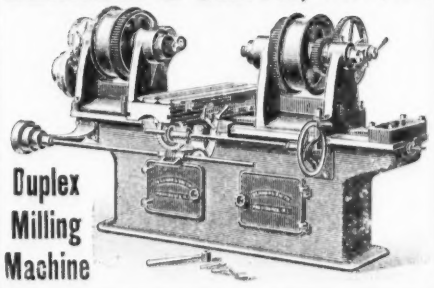
IF YOU WILL TRY THIS TOOL YOU WILL NOT REGRET THE EXPENSE.
C. W. LECOUNT, SOUTH NORWALK, CONN.
SPECIAL MANDRELS FOR SPECIAL JOBS MADE TO ORDER.

PATTERN MAKERS' SHOOT PLANE & JACK BOARD.



A. J. WILKINSON & CO.
Box 3600.
BOSTON, MASS.
SEND FOR CIRCULAR.

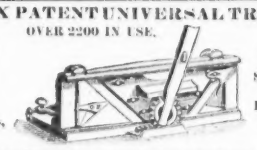
BEAMAN & SMITH, PROV., R. I.



Duplex Milling Machine

PATENT UNIVERSAL SCREW-CUTTING CENTER DEPTH ANGLE AND J. WYKE & CO., TWIST DRILL GAUGE.
Fine Machinists' Tools.—E. Boston, Mass.—Send for Circular.

THE FOX PATENT UNIVERSAL TRIMMER
OVER 2200 IN USE.
ORIGINAL Saves Time, Three Sizes, IMPROVED Saves Money. From New Patterns.



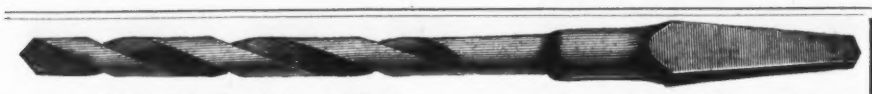
NO PATTERN ROOM COMPLETE WITHOUT THEM
Send for circular. Mention this paper.
THE FOX MACHINE CO., GRAND RAPIDS, MICH.

JUST PUBLISHED.
1 Vol. 12mo., cloth, $1.50.
SLIDE VALVE GEARS.
AN EXPLANATION OF THE ACTION AND CONSTRUCTION OF PLAIN AND CUT-OFF SLIDE VALVES.
BY
FREDERIC A. HALSEY,
MECHANICAL ENGINEER.
FULLY ILLUSTRATED.
ANALYSIS BY THE BILGRIM DIAGRAM.
D. VAN NOSTRAND COMPANY,
23 Murray and 27 Warren Sts., New York.
Copies sent by mail on receipt of price.

"Star" Foot Lathe Swings 9x25 in. | LATHE | Screw Cutting Automatic Cross Feed, etc.
Scroll Saws, Circular Saws, Lathes Mortisers. | Catalogue Free of all our Machinery.
Seneca Falls Mfg. Co. 687 Water St., Seneca Falls, N.Y.

TO INVESTORS OR MANUFACTURERS.
FOR SALE —A desirable article to manufacture,
—A line of heavy machinery
—Which has been well tested.
—Is now in practical use,
—Secured by Patents.
Address, NOTTAD,
Box 44. E. DES MOINES, IOWA.

WORTHINGTON
STEAM PUMPS
SEND FOR NEW EDITION OF GENERAL CATALOGUE
HENRY R WORTHINGTON
88 LIBERTY STREET
NEW YORK



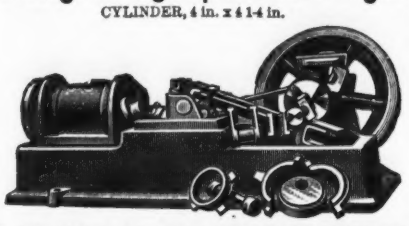
Established in 1874.

CLEVELAND TWIST DRILL CO.

Corner Lake & Kirtland Sts., Cleveland, O.
101 Chambers Street, New York.
85 Queen Victoria St., London, Eng.

Castings for High Speed Steam Engine.

CYLINDER, 4 in. x 4 1-4 in.



T. SHRIVER & CO., IRON AND BRASS FOUNDERS,
333 E. 56th St., N. Y. City.

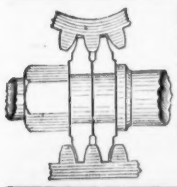
Sets of Castings for Engine illustrated above, with *Cast-steel Shaft, Connecting Rod* and *Rock Shaft*, and *Brass Bearings*, boxed and delivered on boat or cars, in this city, on receipt of $38.00. This includes a *blue print* of working drawing

GLEASON MACHINE TOOLS

Engine Lathes, 22 inch to 72 inch swing.
Iron Planers, 26 inch to 84 inch wide.

HILL, CLARKE & CO.,
156 OLIVER ST., BOSTON.

BEVEL GEARS,
Cut Theoretically Correct.
For particulars and estimates apply to
HUGO BILGRAM,
Machinist,
Successor to
BREHMER BROS.,
440 N. 12th St., Philadelphia, Pa.



CLOUGH'S PATENT DUPLEX GEAR CUTTER

For cutting the teeth of gears; one Duplex Cutter cuts a pitch from 15 teeth to a rack inclusive.
Kept in stock from 4 to 36 pitch and warranted. Circular and price list free.

R. M. CLOUGH,
MERIDEN, CONN.

WELDLESS STEEL TUBES — QUICK OPENING GATE VALVE — COLD DRAWN
SMOOTH INSIDE & OUT.
JOHN S. LENG, 4 Fletcher St. N.Y.

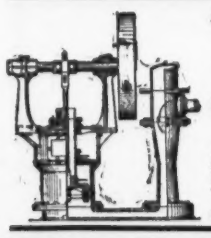
◎ FOR SALE. ◎

PULLEY PATTERNS

A set of Iron Pulley Patterns in halves with curved arms. Diameters from eight to twenty by inches, and to forty-eight inches diameter, varying by two inches. 163 in all. No hubs. These have been set aside for some time by our moulding machines, and are offered for sale, low.

Also one set of Hangers; three sets of Mortising Machine; one set of Moulding Machine; two sets of Spoke Lathe; and one set of Upright Shaper Patterns.

THE LANE & BODLEY CO. CINCINNATI, O.



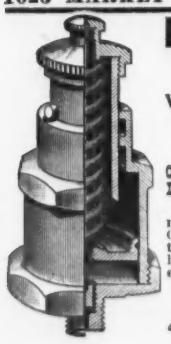
Belt Power Air Pump and Condenser.

CONOVER & CO.,
CONSULTING AND MECHANICAL ENGINEERS
95 LIBERTY ST.,
NEW YORK.

No Air Locks 15 to 50 per cent fuel saved or equal amount of power gained. Runs with same economy as engine.
Adapted to all kinds of Engines. *Send for Circular.*

STUBS PATTERN — FILES — RIFFLERS — NEEDLE FILES — CROBET — PATTERN STUBS — THE WORLD'S BEST

McFADDEN CO.,
1025 MARKET ST., PHILADELPHIA.



LACKAWANNA GREASE CUP

Will Save its Cost in Oil alone Several Times per Annum.

SAVES ALSO IN LABOR AND COST OF COTTON-WASTE, PREVENTS DRIPPING AND SPATTERING.

A POSITIVE FORCE FEED with the most PERFECT REGULATION and GREATEST CONVENIENCE in operation yet attained in any device for the lubrication of machinery. Works equally well in every possible position.

Lackawanna Lubricating Co.,
41 Coal Exchange, Scranton, Pa.

UNIVERSAL RADIAL RADIAL DRILLING MACHINES
THREE DESIGNS. SIX SIZES
EMBODY ALL DESIRABLE FEATURES
PRICES $450.00 & UPWARD
ADDRESS UNIVERSAL RADIAL DRILL CO CINCINNATI O. U.S.A.

SOME NOTABLE ARTICLES

APPEARING IN BACK ISSUES OF THE

AMERICAN MACHINIST.

The following list is published to facilitate the ordering of back numbers containing them. Any of these issues can be ordered through any newsdealer, or of the publishers direct, at the price then ruling, viz.: 5 Cents a Copy.

1886.

Pattern Making, Various Articles on. By F. W. Barrows. Appearing in 29 issues.
Foundry Practice, Various Articles on. By Robt. E. Masters, appearing in 16 issues.
Strength of Different Mixtures of Cast-iron and Method of Testing. By Robt. E. Masters, April 24.
Foundry Practice, Articles on. By Foundryman. [L. C. Jewett.] Aug. 14, Sept. 25, Dec. 18.
Foundry Practice, Articles on. By S. Bolland, May 8, 22, 29, June 26, July 10.
The Morton-Poole Roll Grinding Lathe. By Joshua Rose, J. G. Tramis, Geo. H. Babcock and C. A. Smith, July 3, 24, Aug. 7, 14, 21, Sept. 25.
Machine Shop Cost and Time Accounts. By A. J. Shaw, Henry Metcalfe and C. A. Burton, April 3, 17, May 8.
Tests of Iron. By David Spence, April 17, Oct. 30.
Traction on Grades. By A. B. Ropes, Oct. 30.
Wilson's Valve Gear for Locomotives, Oct. 30.
Casting Face-plates Face Up. By David Spence, Oct. 23.
A Job of Shaft Straightening. By F. L. Johnson, Oct. 23.
Inventory Valuation of Machinery Plant. By Oberlin Smith, Aug. 7.
Making a Cast-iron Sheave. By P. S. Dingey, July 31.
New Dredge Boiler designed by Norman Wheeler, July 17.
Core Oven with Rotating Back. By Thos. Wathey, July 24.
Universal Table for Lathe Change Gears for Screw Cutting. By Joshua Rose, July 24.
Gating, Clamping and Securing Chaplets. By Matthew Wiard, May 1.
Printing Frame and Manner of Making Blue Prints. By C. L. Redfield, July 31.
Some Pressure Tests. By C. O. Sine, Nov. 27.
An Expanding Mandrel—Turning Tapers. By Chas. S. Beach, Nov. 27.
Core Making in Foundries. By David Spence, Nov. 20.
Making Pattern for Spiral Grooved Drum. By Geo. Allge, Aug. 14.
Rolling Conic Sections Applied to Gears. By Geo. B. Grant, Nov. 6.
Ninety-inch Belpaire Fire-box Boiler, Nov. 6.
Spacing in the Milling Machine. By Chas. S. Beach, Aug. 21.
Engine Crossheads. By J. G. Tramis, Aug. 21.
Traction and Adhesion. By A. B. Ropes, Aug. 28.
Internal Key-seating on Milling Machines. By A. B. Landis, April 17.
Tapping Holes in Boilers. By A. B. Landis, April 24.
How to True Emery Wheels. By L. Best, April 24.
Work and System in the Drawing-room. By C. L. Redfield, Aug. 28.
Oiling Lathe Carriage Ways. By Wm. H. Bradt, Aug. 28.
Moulding a Screw or Worm without Cores. By George Allge, Sept. 11, 18.
Power Absorbed in Cutting Cast-iron. By James F. Hobart, Sept. 11, 18.
Moulding Screw Propellers in Loam. By Chas. A. Devlin, Sept. 18.
Dimensions of Wrought iron Pipes in England. By A. G. Brown, Sept 4.
Truing Up and Replacing Milling Machine Centers with Accurate Alignment. By A. B. Landis, Jan. 16.
Methods of Working and Tempering Steel. By S. W. Goodyear, Jan. 9.
Slotting Tool. By J. J. Bingley, May 8.
How to Make Clean Solid Castings at Least Possible Cost. By Matthew Wiard, April 10.
Truing Milling Machine Centers. By W. R. Ballou, April 10.
Lining Engine Lathes. By Chas. S. Beach, April 10.
Steam Piping. By J. G. Tramis, April 10.
An Equalizing Dog. By A. B. Landis, April 10.
Screw Cutting Dies. By John J. Grant, April 10.
Some Handy Shop Tools. By Fred. H. Colvin, April 3.
Moulding Bells for Blast Furnaces in Green Sand Without Patterns. By Geo. O. Vair, April 3.
Furnace for Heating Long Bars. By W. G. Richards, April 3.
Cutting Tools—Roll Turning. By S. W. Goodyear, Oct. 16.
Hydraulic Forging. By J. Richards, July 10.
A "Box" Jig. By C. E. Simonds, June 19.
Cheap Testing Machine. By Wm. Merrill, Feb. 6.
Boring Deep Holes. By A. B. Landis, Mar. 27, May 8.
Working Steel and Iron. By S. W. Goodyear, Feb. 13.
Inventory Valuations of Patterns. By W. E. Matheson and others, Jan. 9, Feb. 13, 20, Mar. 6.
Making Cast-iron Half Boxes. By A. J. Shaw, Feb. 6.
Draining Steam Pipes. By W. E. Crane, Feb. 6.
Brazing and Welding Iron. By J. F. Hobart, Mar. 6.
Deep Holes by Continuous Boring. By A. B. Landis, Mar. 27.
Slotting Machine Tool. By Wm. Foster, Mar. 20.
Compound Engines for Stationary or Factory Purposes. By W. H. Hoffman, April 24, May 1, 22.
Engineering Subjects, Articles on. By W. H. Hoffman, Mar. 13, July 24, 31, Aug. 21, Oct. 9.
Self-contained Engines. By W. H. Hoffman, Feb. 27, Mar. 6.
Curving Qualities of Locomotives with High and Low Centers of Gravity, Oct. 16.

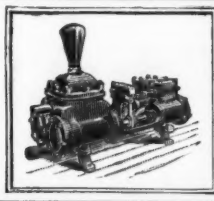
HALL DUPLEX STEAM PUMPS.

Send for 1890 Catalogue.

Fire Pump.

HALL STEAM PUMP CO.,
91 LIBERTY ST., NEW YORK.
PITTSBURGH. CHICAGO. ST. LOUIS.

Boiler and Pump Combined.

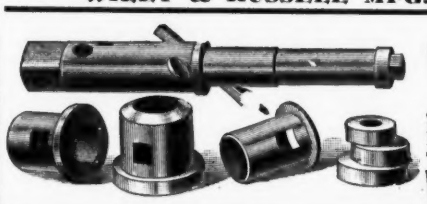


THE BUFFALO STEAM PUMP CO.
BUFFALO, N.Y. — MANUFACTURERS OF
STEAM PUMPS
FOR ALL DUTIES.

CRUCIBLE AND OPEN HEARTH
CAMERON SELF-HARDENING
STEEL
ESTABLISHED 1859.
HOWE, BROWN & CO., L't'd, Mfrs., Pittsburgh, Pa.
BRANCH OFFICES: 12 Cliff St., New York. 127 Oliver St., Boston. 228 Lake St., Chicago.

FINE TAPS, DIES, REAMERS, ETC.

LIGHTNING AND GREEN RIVER SCREW PLATES.
Bolt Cutters, Hand and Power Drilling Machines, Punching Presses, Tire Benders, Tire Upsetters and Other Labor-Saving Tools. Send for Price List.
WILEY & RUSSELL MFG. CO., GREENFIELD, MASS.



—THE—
Vance Lightning Flue Cutter

For removing Flues from Locomotive and Stationary Boilers. One man can cut five hundred (one end) in a day. In use in the leading Railroad Shops of the country. Combination Cutter for removing 2 in., 2 1-4 in., 2 1-2 in. and 3 in. Flues, $50. Sent on approval to Railroad Co's. Liberal Discounts to the Trade.

VANCE TUBE CUTTER CO., Geneva, N. Y.

Maslin's Patent Pulsator Pump.

PAT. FEB. 12, 1889.

Cheapest and Best Automatic Steam Vacuum Pump. Handling DIRTY and GRITTY LIQUIDS without Wear, Oil or Care. Simple, Economical, Efficient & Durable. Pumping Plants for Contractors, Irrigation, Water Works, Railroads, Mining & General Hydraulic Purposes. Write or call for Circulars. JOHN MASLIN & SON, SOLE MANUF'RS. 165-167 1st St., Jersey City, N. J.

PECK'S PAT. DROP PRESS.
BEECHER & PECK, NEW HAVEN CONN.
DROP FORGINGS OF IRON OR STEEL
BEECHER & PECK, NEW HAVEN CONN.

3/8" **FLEXIBLE METALLIC FILLET**
For Pattern Makers' Use.
H. WHITE, 44 N. 4th Street, Phila., Pa.

VAN DUZEN'S
STEAM JET PUMP

For Water Supply Tanks.
For Fire Pump on Yard or Switch Engines.
For Round House General Work.
For Draining Ponds, Pits, Coffer Dams, etc.
10 Sizes. $7 to $75. Thousands in use.
Write for Descriptive Pump Circular, A.
VAN DUZEN & TIFT, CINCINNATI, O.

T. R. ALMOND, 85 Washington St., Brooklyn, N. Y., is prepared to *grant licenses* on moderate terms for the use of his

Patent Loose Pulley Lubricating Device,

illustrated in this paper, Jan. 23, 1890 issue. One tablespoonful of oil will last for months.

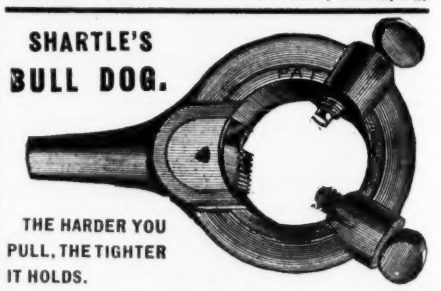
DROP FORGING.
SPEIRS & MOORE, WORCESTER, MASS.

MACHINE TOOLS

ENGINE LATHES,
BRASS LATHES,
BORING AND TURNING MILLS,
SCREW MACHINES,
on hand and in process of construction.

BRIDGEPORT MACHINE TOOL WORKS,
E. P. BULLARD, PROPRIETOR. BRIDGEPORT, CONN.

SHARTLE'S
BULL DOG.



THE HARDER YOU PULL, THE TIGHTER IT HOLDS.

CLASS "B"

This style is made for general machine shop use from 1 3-4 in. to 8 in. or larger. Can't slip. No wrench required, and satisfaction guaranteed. Write for catalogue showing the different styles. MANUFACTURED BY
THE MIDDLETOWN (OHIO) MACHINE CO.

STEAM — WATER — TO THE BOILER

PARK Double Jet INJECTOR
PARK MFG. CO.,
53 Portland Street,
Boston, Mass.

THE most reliable under varying steam pressure of any injector known. Will work from 15 pounds to 180 pounds without any adjustment. The only **Automatic Injector** that will thoroughly drain itself when shut off, thus preventing freezing. *Every Machine Guaranteed.*

INJECTORS AND JET APPARATUS.

Root's Force Blast Rotary Blower.

FOR
FOUNDRIES, SMITH SHOPS, PNEUMATIC TUBES, VENTILATION, ETC.

SLOW SPEED, POSITIVE BLAST, PERFECTLY BALANCED.
Best Mechanical Construction.
P. H. & F. M. ROOTS, Manufacturers,
CONNERSVILLE, IND.
S. S. TOWNSEND, Gen. Agt. } 22 Cortlandt St.,
COOKE & CO., Selling Agts. } NEW YORK.

In Writing, Please Mention This Paper.

SUGGESTIVE FACTS FOR STEAM USERS.

BEMENT, MILES & CO., PHILADELPHIA.

After the fullest investigation, have just ordered a battery of 402 H. P. of Harrison Safety Boilers for the large addition now being built to their extensive works.

Pamphlet describing and illustrating the type of boiler they selected mailed upon application to

HARRISON SAFETY BOILER WORKS,

Germantown Junction, Philadelphia, Pa.

NEW YORK, N. Y. 41 Dey Street. CHICAGO, ILL. 6 So. Canal Street. ATLANTA, GA. 9 No. Pryor Street. MINNEAPOLIS, MINN. 707 Lumber Exchange.

POND ENGINEERING CO.,

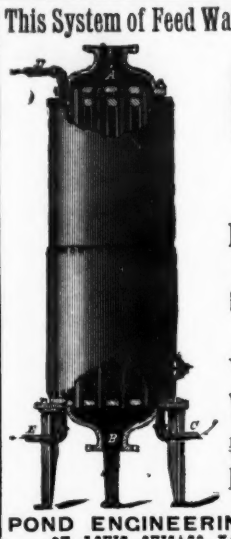
CONTRACTING ENGINEERS,

Engines, Boilers, Pumping Engines, Feed Pumps, Feed-water Heaters and Purifiers, Injectors, &c.

Send for ILLUSTRATED CIRCULAR.

St. Louis. Chicago. Kansas City. Omaha.

This System of Feed Water Heater is the Best



AND THE

LOWE

is the simplest

HEATER

on the System.

Has Straight Tubes

With reliable provision for expansion, and will

HEAT AND PURIFY THE WATER

EQUAL TO ANY

With same Feet of Heating Surface and

Wear the Longest.

Send for description and Histories of Boilers and Feed Water Heaters to

Bridgeport Boiler Works

Bridgeport, Conn.

POND ENGINEERING CO., AGENTS,

ST. LOUIS, CHICAGO, KANSAS CITY, OMAHA.

WESTCOTT CHUCK CO., Oneida, N.Y., U.S.A.

MANUFACTURERS OF

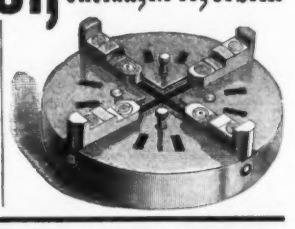
LATHE and DRILL

CHUCKS.

SEND FOR ILLUSTRATED CATALOGUE.

Independent Chucks.
Jaws Reversible.
Four Jaws.

Diameter.	Capacity.
7⅛ inch.	7⅛ inch.
10⅜ "	10⅜ "
13 "	13⅛ "
15¼ "	17 "
18 "	19¾ "
21 "	25⅛ "
24 "	28 "



HYDROSTATIC MACHINERY,

PRESSES, PUMPS, PUNCHES,

ACCUMULATORS,

JACKS,

VALVES,

FITTINGS,

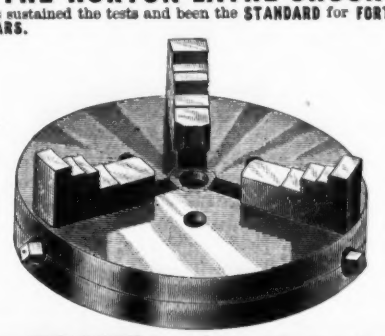
&c., &c.

WATSON & STILLMAN,

204, 206, 208 & 210 E. 43D ST., N. Y.

"THE HORTON LATHE CHUCK"

has sustained the tests and been the STANDARD for FORTY YEARS.



Over THREE HUNDRED sizes and styles of Chucks, made and kept in stock, by

THE E. HORTON & SON CO.,

WINDSOR LOCKS, CONN., U. S. A.

SEND FOR ILLUSTRATED PRICE LIST.

VOLNEY W. MASON & CO.,

Friction Pulleys, Clutches and Elevators,

PROVIDENCE, R. I.

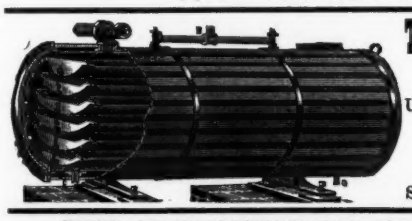
THE STERLING WATER TUBE BOILERS

Have unusually large steam and water spaces and well-defined circulation. The fire-brick furnace and almost vertical water tubes give remarkable economy of fuel with rapid and steady steaming. Dry steam at any pressure. Large mud-drum. First cost moderate. Freedom from leakage and repairs. No cast metal. No hand-holes. Three man-holes give quick access to every part of the boiler.

THE INTERNATIONAL BOILER CO., Ltd.,

74 CORTLANDT STREET, NEW YORK.

AMATEUR'S CHUCKS
BOTH LEVER AND GEARED SCROLL
DESIGNED FOR FOOT LATHES AND FOR GENERAL MACHINISTS WORK
Send for New Descriptive CATALOGUE
Sold by all dealers
LEVER CHUCK
To THE CUSHMAN CHUCK CO. HARTFORD, CONN.
GEARED CHUCK



The HOPPES Live-Steam Feed-Water Purifier,

Guaranteed to Prevent Scale in Boilers.

Using any kind of water. Hard Sheet Steel Troughs, *Easily Cleaned.*

HOPPES MANUFACTURING CO.,

Send for Catalogue D. SPRINGFIELD, OHIO.

"SWEETLAND" CHUCKS

SEND FOR DISCOUNTS.

THE HOGGSON & PETTIS MFG. CO.,

Est. 1849. NEW HAVEN, CONN.

WM. BERKEFELD'S FOSSIL MEAL COMPOSITION.

The best non-conducting material known for Steam Pipes and Boilers. Can be easily removed and repeatedly reapplied.

ITS PLASTIC NATURE INSURES AN ABSOLUTELY TIGHT JOINT.

Requires less thickness than any other covering.

Trade-mark. W. B. C.

FOSSIL MEAL CO., 2 Cedar St., N. Y.

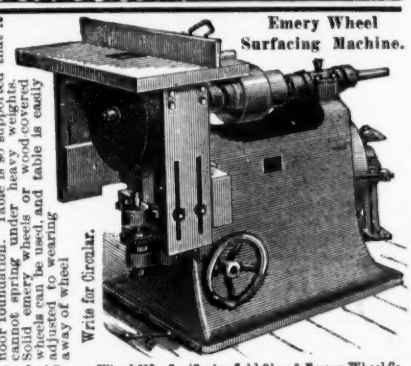
PINION KEY CHUCKS.

A geared scroll chuck with the pinion on the key shaft. It has been used for years by the largest electrical and instrument factories in the U. S. It is warranted durable and true. Ask for it at your dealer's.

THE D.E.WHITON MACHINE CO.

NEW LONDON, CONN.

S. A. SMITH, 23 S. Canal St, Chicago, Western Agt.


Emery Wheel Surfacing Machine.
Base of machine has sufficient flare to give solid floor foundation. Tube is so supported that it cannot spring under heavy weights.
Solid emery wheels or wood-covered wheels can be used, and table is easily adjusted to wearing away of wheel
Write for Circular.

Springfield Emery Wheel Mfg. Co., Successors to Springfield Glue & Emery Wheel Co., BRIDGEPORT, CONN.

Western Branch, 18 and 20 West Randolph Street, Chicago, Ills.

PATENT OILERS, CYLINDER SIGHT FEED CUPS.

Government Regulation

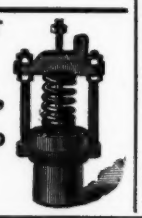
POP SAFETY VALVES,

For Stationary, Marine and Locomotive Boilers.

J. E. LONERGAN & CO., BRASS FOUNDERS AND FINISHERS,

211 Race Street, Philadelphia, Pa.

1888 CATALOGUE FREE ON APPLICATION.



AGENCY FOR GERMANY.

A technical firm at Berlin demands to represent respectable manufactories for machines wishing to import salable specialties to Germany. Offers sub. I. Z. 8600 to send to Mr. RUDOLF MOSSE, Berlin, S. W.

ALUMINUM, $2 PER POUND.

THE PITTSBURGH REDUCTION COMPANY, 95 Fifth Avenue, Pittsburgh, Pa., U. S. A., offer commercially pure aluminum at the following rates at Pittsburgh, Pa.:

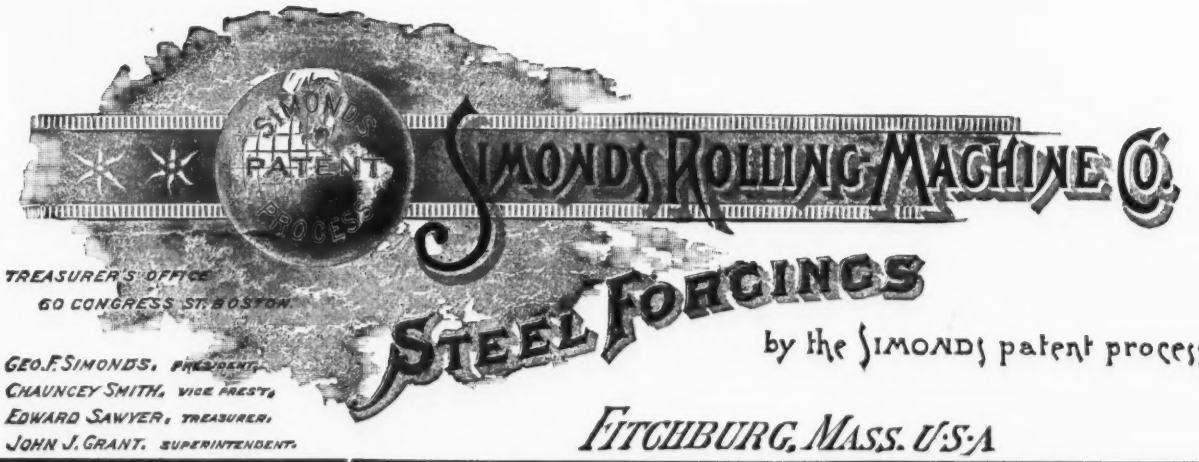
Lots of 1,000 lbs. and over.....$2.00 ℔
Lots of 500 lbs. and over..... 2.25 ℔
Lots of 100 lbs. and over..... 2.50 ℔

Metal guaranteed to be equal in quality to the best metal manufactured by any other process.

Prices on sheets, wire, tubes or castings given upon application.

Steel Balls from $\frac{3}{16}$ inch to $2\frac{5}{8}$ inch for Anti-Friction Bearings a Specialty.

SEND FOR CATALOGUE.



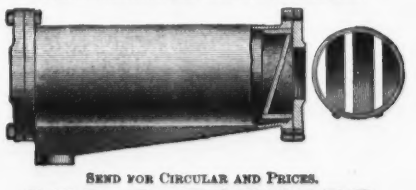
BARNARD'S SEPARATOR

For Separating and Removing Entrained Water from Live Steam;

AND

Condense Water, Oil, Dirt, Etc., from Exhaust Steam.

SPECIAL DESIGNS FOR SURFACE CONDENSERS.



SEND FOR CIRCULAR AND PRICES.

GEO. A. BARNARD,

15 CORTLANDT ST., NEW YORK.

GRAPHITE

Plumbago

BLACK LEAD

Ground and prepared in quantities from ¼ lb. to a shipload. Lubricating Graphite a specialty. If you are at all interested in Graphite it will pay you to correspond with us, as different kinds are required for different purposes. All letters promptly answered.

Jos. Dixon Crucible Co.,

JERSEY CITY, N. J.

SIMPSON'S CENTRIFUGAL EXHAUST HEAD.

Thoroughly entraps water and grease from the exhaust of a steam engine without back pressure, preventing them from spraying on the sidewalks and roofs of buildings; it protects the latter from injury, and passers by from annoyance and damage. Send for circular to

KEYSTONE ENGINE & MACHINE WKS.,

5th and Buttonwood Sts., Phila., Pa.,

Or A. T. ARTHUR, Selling Agent, 18 Cortlandt Street, N. Y.

CHARLES MURRAY

ENGRAVER ON WOOD

58 ANN ST. NEW YORK.

SPRUE CUTTERS. SHEARS. TOGGLE-JOINT DRAWING PRESSES.

STILL IN THE LEAD!

THE ONLY AMERICAN FIRM

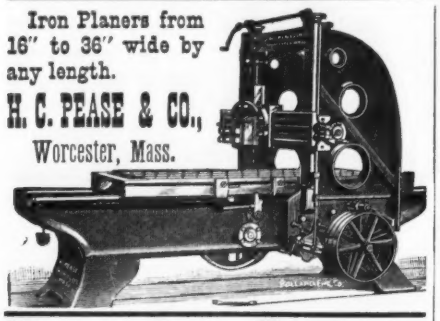
AWARDED

A GOLD MEDAL AT THE PARIS EXPOSITION 1889.

FOR SUPERIORITY IN PRESSES, DROP HAMMERS AND DIES.

THE STILES & PARKER PRESS CO.,

203-207 Centre Street, NEW YORK. MIDDLETOWN, CONN.



Iron Planers from 16" to 36" wide by any length.

H. C. PEASE & CO.,

Worcester, Mass.

Pease Iron Planers.

All Sizes from 16 in.x16 in.x4 ft. to 36 in. x36 in.x12 ft. inclusive carried in stock.

HILL, CLARKE & CO.,

156 OLIVER ST., BOSTON, MASS.

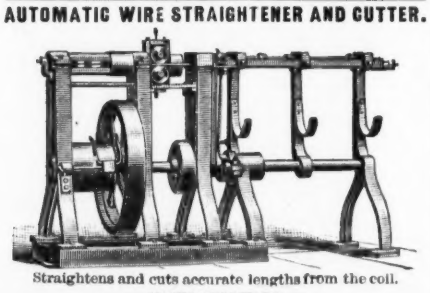
THE MELICK CLINOMETER

Is offered to Engineers, Machinists, Carpenters and others, as a positive and accurate instrument for striking levels, angles or for plumbing. It is superior in every respect to the spirit level. It is the first practical substitute for the spirit level ever offered to the public. It is also adapted to running grades and inclines of any degree from half inch to twelve inches to the foot. Send for circular.

Melick Clinometer Co., 718 St. Charles St.,

ST. LOUIS, MO.

AUTOMATIC WIRE STRAIGHTENER AND CUTTER.



Straightens and cuts accurate lengths from the coil.

—MANUFACTURED BY—

COLLINS-GOODIN MFG. CO., - ST. LOUIS, MO

LATHE

FOR

TOOL MAKING, MODEL MAKING.

Waltham, Mass.

SCREW CUTTING, GRINDING AND EXTRA FINE WORK.

SEND FOR BOOK OF DESCRIPTION

Barnes' Foot-Power Machinery.

Complete outfits for Actual Workshop Business. A customer says: "Considering its capacity and the accuracy of your No. 4 Lathe, I do not see how it can be produced at such low cost. The velocipede foot-power is simply elegant. I can turn steadily for a whole day, and at night feel as little tired as if I had been walking around." Descriptive Price List Free.

W. F. & JOHN BARNES CO.,
1995 RUBY ST., ROCKFORD, ILL.

MACHINISTS' FINE TOOLS.

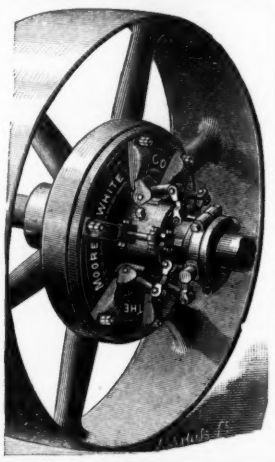
STANDARD TOOL CO., ATHOL, MASS.

Catalogue and Price List free.

THE MOORE & WHITE CO.,

Philadelphia, Pa.

Friction Clutch Pulleys, Cut-off Couplings, &c.



EMPLOYERS' LIABILITY ASSURANCE Corporation Limited London. Eng.

Deposited in the U. S., $670,000.00.

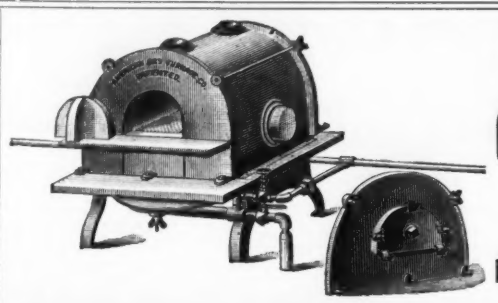
Trustees for the United States.

OLIVER W. PEABODY, Esq., Kidder, Peabody & Co., Boston.
CHAUNCEY M. DEPEW, Esq., Pres. N. Y. C. & H. R. R. R. Co., New York.
SAMUEL SLOAN, Esq., Pres. D., L. & W. R. R. Co., New York.
WM. A. FRENCH, Esq., Pres. Mass. Nat'l Bank. Abram French & Co., Boston.
HON. JOHN LOWELL, Boston.

Chief Office in United States, 71 Kilby St, Boston, Mass.

ENDICOTT & MACOMBER, Managers & Attorneys.

AGENTS IN ALL CITIES.



American Gas Furnace Co.,

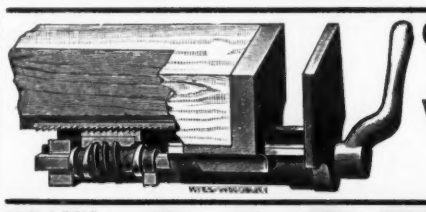
Designers and Manufacturers

GAS BLAST FURNACES.

Send for Catalogue. Estimates made for any mechanical operation requiring **high, even** and **controllable temperature.**

No. 80 NASSAU STREET,

NEW YORK.



QUICK-ACTION VISES,

For Pattern Makers and Wood Workers.

WYMAN & GORDON,

WORCESTER, MASS.

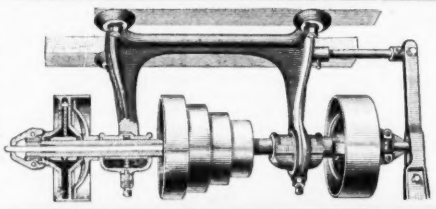
DROP FORGINGS.

HEAVY AND LIGHT **CASTINGS** IRON OR BRASS

ARTHUR R. KING FOUNDRY & MACHINE WORKS,

ERIE, 11th & 12th STS., JERSEY CITY, N. J.

GENERAL MACHINE WORK. CORRESPONDENCE INVITED.



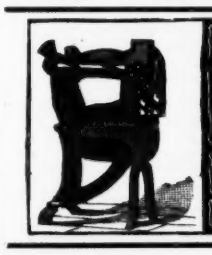
A MODERN COUNTERSHAFT.

ATTENDS TO ITSELF.

A new and Perfect Friction Clutch. Self-oiling throughout. Self-oiling pulleys that do not spill. Tested by one year's use. Saves care, worry and money.

THE STATES MACHINE CO.,

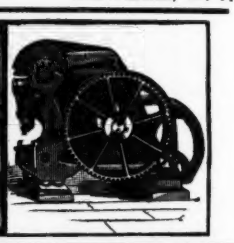
R. R. Place and Commerce St., NEWARK, N. J.

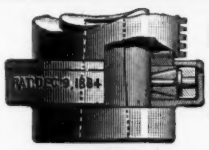


PUNCHING AND SHEARING MACHINERY AND BOILER MAKER'S ROLLS.

NEW DOTY MANUFACTURING CO.

JANESVILLE, WISCONSIN.





THE BROWNELL ANTI-FRICTION **Step or Thrust Bearing**

FOR

Lathes, Drills, Worm Shafts of Elevators or Hoists, Jack Screws, Mill Stones, Water Wheel and Propeller Shafts.

Bearings of all sizes made to order, and patent rights for sale by

G. L. BROWNELL,

WORCESTER, MASS.

Correspondence Solicited.

SCROLL SAWS

THE

FLEETWOOD & DEXTER

ARE THE BEST.

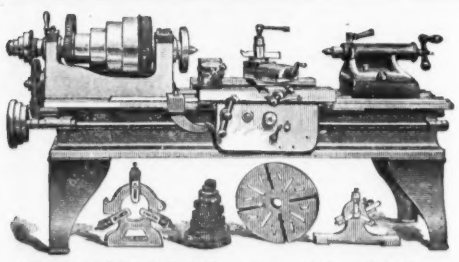
THOUSANDS SOLD.

Write for Illustrated Price Lists to

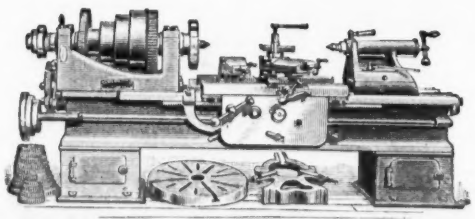
TRUMP BROS. MACH. CO.

Manufacturers.

WILMINGTON, DEL., U. S. A.

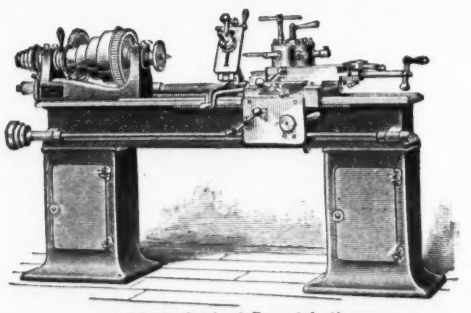


17, 19 and 21-inch Swing Large Hollow Spindle.



24, 27, 32 and 38-inch Swing, Cabinet Legs.

Taper Attachment, Automatic Stop, Compound Rest, Lead Screw under front V. All feeds reversed in apron. Extra heavy, Convenient, and easily handled.



18-inch Cabinet Turret Lathe.

Taper Attachment, Automatic Feed, Lever and Screw Movement, most complete brass lathe on the market.

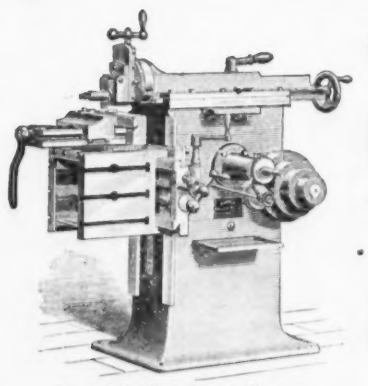
THE LODGE AND DAVIS MACHINE TOOL CO.

Works, CINCINNATI, OHIO.

EASTERN HOUSE,
64 Cortlandt Street, New York.

WESTERN HOUSE,
68 & 70 S. Canal Street, Chicago.

COMPLETE MACHINE SHOP EQUIPMENTS A SPECIALTY.



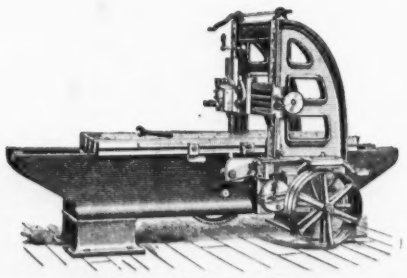
15 and 20-inch Crank Shaper.

Stroke changed and adjusted while running. Stroke at all times positive. Invariably plane to a line.

Engine Lathes

Turret Lathes

Iron Planers



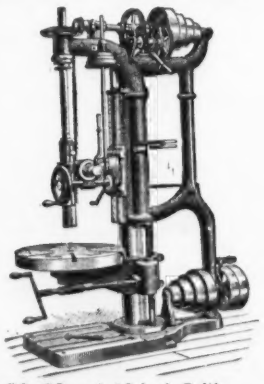
24, 32 and 40-inch Planer.

Extra deep bed and table. Powerfully geared. Ex raordinary power. Plenty of Metal. Feeds Shipper operated from either side.

Drill Presses

MILLING MACHINES

Iron Shapers

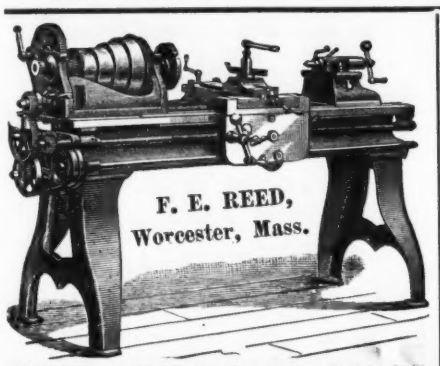


25, 28, 32 and 40-inch Drills.

Automatic stop to feed. Quick return on right side. Table operated from front. Large cones and long belts.

MORSE TWIST DRILL AND MACHINE COMPANY, New Bedford, Mass.
Manufacturers of **Morse Patent Straight-Lip Increase Twist Drills.**

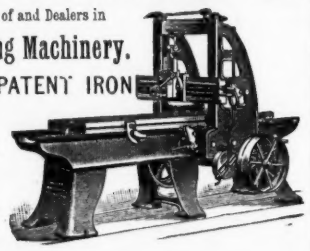
Solid and Shell Reamers, Beach's Patent Self-Centering Chuck, Bit Stock Drills.
DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.



ENGINE Lathes, Hand Lathes, Foot Lathes, Upright Drills and Milling Machines. Agents, MANNING, MAXWELL & MOORE, 111 LIBERTY STREET, NEW YORK.

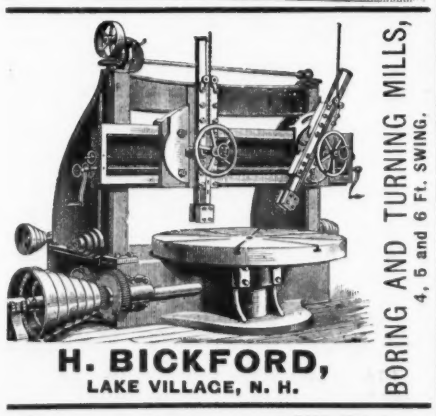
FLATHER ENGINE LATHES
14, 15, 16, 18, 20, 24 and 28 INCH SWING.
ANY LENGTH OF BED UP TO 22 FEET.
HILL, CLARKE & CO.,
General Selling Agents,
156 OLIVER ST., BOSTON, MASS.

L. W. POND MACHINE CO.
Manufacturers of and Dealers in
Iron Working Machinery.
IMPROVED PATENT IRON PLANERS A SPECIALTY.
152 Union St., WORCESTER, MASS.

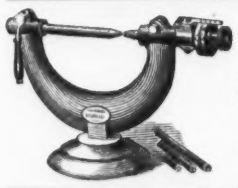


L. W. POND PLANERS.
FOR QUICK DELIVERY.
One Planer 38 in. x 38 in. x 10 ft.
One Planer 44 in. x 40 in. x 12 ft., with 2 heads.
HILL, CLARKE & CO.,
156 OLIVER ST., - BOSTON, MASS.

L. S. STARRETT,
Manufacturer of
FINE TOOLS,
ATHOL, MASS.
SEND STAMP FOR FULL LIST.

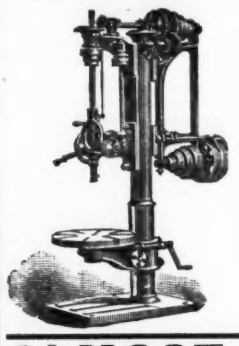


TURNING MILLS, 4, 5 and 6 Ft. SWING.
H. BICKFORD,
LAKE VILLAGE, N. H.



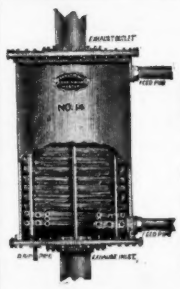
SWEET'S
Measuring Machine.
The only micrometer that will not lose its accuracy by wear.
Satisfaction Guaranteed.
SYRACUSE TWIST DRILL CO.
Syracuse, N. Y.

NEW HAVEN MANUF'G CO.,
New Haven, Conn.



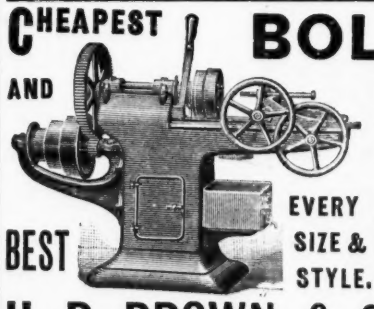
Lathes,
Planers,
Shapers,
Slotters,
Etc.

ALMOST READY
OUR NEW ILLUSTRATED CATALOGUE OF
Turret Machinery.
MANY NEW FEATURES.
JONES & LAMSON MACHINE CO.,
SPRINGFIELD, VERMONT.
SEND FOR IT.

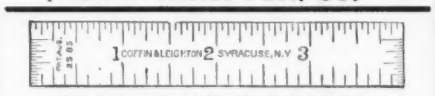


THE NATIONAL Feed-Water HEATER.
A brass coil Heater delivering water to the boiler at 210° Fahrenheit.
300,000 Horse Power sold. Prices Low. Satisfaction universal.
THE NATIONAL PIPE BENDING CO.,
32 River Street, NEW HAVEN, CONN.

CHEAPEST AND BEST BOLT CUTTERS.



EVERY SIZE & STYLE.
H. B. BROWN & CO.,
EAST HAMPTON, CT.



MACHINIST'S SCALES,
PATENT END GRADUATION.
We Invite Comparison for Accuracy with all others.
EVERY SCALE GUARANTEED. SEND FOR LIST.
COFFIN & LEIGHTON, SYRACUSE, N. Y.

FACTORY, HOBOKEN, N. J.
Manufacturers of
Drawing Materials, Etc.,
Superior Swiss Drawing Instruments, Extra and Best Quality, German Drawing Instruments.
Paragon, Duplex, Universal, Anvil Drawing, Helios, Blue Process Papers, Scales, Triangles, T-Squares, Drawing Boards, Standard Profile and Cross-section Papers.
Catalogue to professional people on application.

THE "EUREKA" PIPE CUTTER
IS THE BEST AND CHEAPEST MADE.
No. 1 Cuts ⅛ to 1 inch Pipe $1.00
No. 2 " ¾ to 2 " " 1.50
No. 3 " 1 to 2 " " 4.65
Nos. 1 and 3 will cut all sizes from ⅛ to 3 inch
Any Jobber can furnish this tool to you at these prices.
PANCOAST & MAULE,
243 and 245 South Third Street, Philadelphia.

A NEW JAW
about once a year will make this Cutter last until you forget when you bought it, as the body never wears out.
Warranted to Cut Straight.

CARY & MOEN CO.
STEEL WIRE OF EVERY DESCRIPTION & STEEL SPRINGS.
NEW YORK CITY

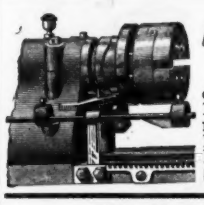
W. C. YOUNG & CO., Worcester, Mass
Manufacturers of
Engine Lathes, Hand Lathes,
FOOT POWER LATHES, SLIDE RESTS, ETC.

D. SAUNDERS' SONS, Yonkers, N. Y.
MANUFACTURERS OF
Steam & Gas Fitters' Hand Tools.
SEND FOR CIRCULAR.

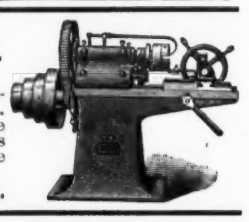
Pipe Cutting THREADING, AND Tapping Machines.

THE PATENT WHEEL PIPE CUTTER shown in the cut combines simplicity with strength and lightness. Easily adapted to various sizes of pipe. Rolling instead of sliding motion. No loose parts to become detached and mislaid. All wearing surfaces are of tool steel hardened. Less friction of parts than any other pipe-cutter made.

BUFFALO FORGES
BLOWERS, EXHAUSTERS, HEATING FURNACES.
HAND BLOWERS, BLACKSMITH DRILLS.
BUFFALO FORGE CO.
BUFFALO, N.Y.

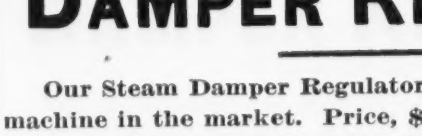


ADAMS
Automatic Bolt-Threading & Nut Tapping Machine.
Made in all Sizes to Cut from 1-4" to 6".
The simplest and most durable machine in existence. The threading head is made entirely of steel. No links, levers, springs, caps, cases, blocks or die rings in or about the head. Separate Heads and Dies Furnished. Write for descriptive circular and price list to
Capitol Mfg. Co., Rees St. near Halsted, Chicago, Ill., U. S. A.

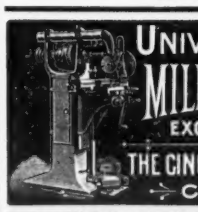


NO MACHINE SHOP CAN AFFORD TO BE WITHOUT
NICHOLSON'S EXPANDING MANDRELS.
Write for new Price List. W. H. NICHOLSON & CO., Wilkes-Barre, Pa.

Blaisdell Engine Lathes.
All Sizes from 14 in. to 30 in. swing carried in stock.
HILL, CLARKE & CO.,
156 OLIVER ST., BOSTON, MASS.

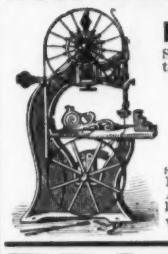


These Hack Saws will cut Iron and Steel beyond all expectation.
Iron working mechanics everywhere must and will use them. They do the work of files at one-tenth the cost, and in one-tenth the time. One Patent Nickel-plated Steel frame, and one dozen 8 inch Blades, sent by mail, prepaid, on receipt of $1.50. Hardware dealers will furnish them at at the same price. All saws marked with a star, and bearing our name are fully warranted.
MILLERS FALLS CO.,
93 Reade Street, New York



UNIVERSAL AND PLAIN MILLING MACHINES
EXCLUSIVE SPECIALTY
ADDRESS
THE CINCINNATI MILLING MACH'N CO.
CINCINNATI, O.

J. A. FAY & CO. CINCINNATI, OHIO, U.S.A.
BUILDERS OF IMPROVED
WOOD-WORKING MACHINERY
Embraces nearly 400 Machines for
PLANING & MATCHING
Surfacing, Moulding, Tenoning, Mortising, Boring, and Shaping, etc.
Variety and Universal
WOOD WORKERS.
Band, Scroll and Circular Saws, Resawing Machines, Spoke and Wheel Machinery, Shafting, Pulleys, etc. All of the highest standard of excellence.
W. H. DOANE, Pres. D. L. LYON, Sec'y.



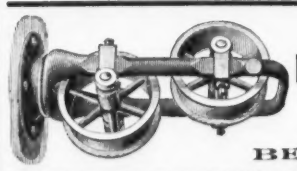
WILLIAM BARKER & CO.,
Manufacturers of
Iron and Brass Working
MACHINERY,
140 & 142 E. SIXTH ST.,
Near Culvert,
CINCINNATI, O.
Send for Circulars and Prices.

CURTIS & CURTIS,
6 Garden St., Bridgeport, Ct., U.S.A.
MANUFACTURERS OF
The Forbes Pat. Die Stock,
IMPROVED AND PERFECTED.
Pipe Cutting and Threading Machine, etc.
A portable cutting and threading machine with which one man can with ease thread pipe up to six inch diam. No vise is required.
SEND FOR ILLUSTRATED CATALOGUE.
Ratchet Drills, Ratchet Die Stocks and Malleable Iron Pipe Vises.

SAVE YOUR MONEY BY USING
RIDER'S
"Victor" Lathe and Planer Tool.

Cutters made direct from bar of Round Steel. *No filing* required. Send Square or for prices.
FRANK L. B. RIDER, South Newmarket, N. H.

BOYNTON & PLUMMER,
WORCESTER, MASS.
Manufacturers of
Shaping Machines,
Drilling Machines,
Bolt Cutting Machines.
Send for Catalogue.



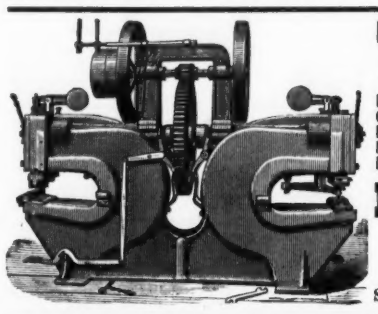
GUIDE PULLEYS FOR LIGHT BELTS.
JOHN ROYLE & SONS, PATERSON, N. J.

FRICTION CLUTCH PULLEYS AND CUT-OFF COUPLINGS
JAS. HUNTER & SON,
North Adams, Mass.

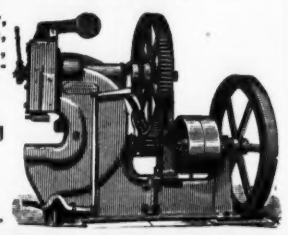
DAMPER REGULATORS.

Our Steam Damper Regulator is the most perfect and simplest machine in the market. Price, $60 and $100. Any one can apply it. Send for circular to Mason Regulator Co., Boston.

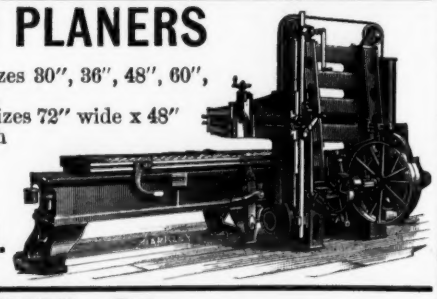
WILLIAM SELLERS & CO., Incorporated.
PHILADELPHIA, PA.
BUILDERS OF
MACHINE TOOLS FOR WORKING IRON AND STEEL,
Improved TURNTABLES for LOCOMOTIVES, CARS and PIVOT BRIDGES.
High Speed Power Traveling Cranes and Hand or Power Swing Cranes, Shafting, Pulleys, Hangers, &c., for transmission of power. Improved Self-Adjusting Injector of 1876. Self-Acting Injector of 1887. Fixed-Nozzle Automatic Injector of 1885.
INJECTORS for ALL CONDITIONS of LOCOMOTIVE and STATIONARY SERVICE



THE LONG & ALLSTATTER CO. Hamilton OHIO.
Double, Single, Angle-Bar, Gang, Horizontal, Twin, Boiler, Spacing, Gate, Multiple, Belt and Steam-Driven
Punches and Shears,
OVER 300 SIZES.
ALSO
Power Cushioned Hammer.
Send for New Catalogue.



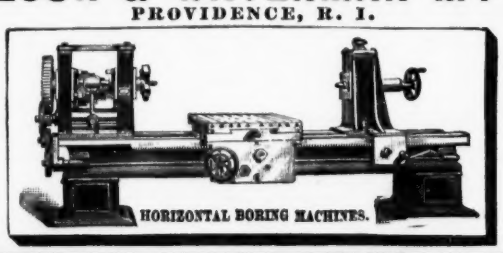
THE OPEN-SIDE IRON PLANERS
STANDARD OPEN-SIDE PLANER, Sizes 30″, 36″, 48″, 60″, by any desired length.
OPEN-SIDE EXTENSION PLANERS, Sizes 72″ wide x 48″ high x 10′ long, up to 120″ wide x 72″ high x 20′ long.
Open-Side Frog and Switch Planers.
Extra Heavy and Powerfully Geared Up.
The DETRICK & HARVEY MACHINE CO.
BALTIMORE, MD.



ACME MACHINERY CO.
CLEVELAND, OHIO.
Manufacturers of
ACME BOLT & RIVET HEADERS,
Acme Single & Double Automatic BOLTCUTTERS.
Cutting from 1-8 in. to 6 in. diameter.
Also SEPARATE HEADS and DIES.
FIRST PREMIUM, CINCINNATI CENTENNIAL.

PAT. DEC. 5, 1882.
PAT. DEC. 4, 1883.
PAT. AUG. 25, 1885.

NICHOLSON & WATERMAN M'F'G CO.,
PROVIDENCE, R. I.
LATHES.
CUTTING-OFF MACHINES,
TRAVERSE DRILLS,
TRAVERSE BORING MACHINES,
SPECIALS,
&c., &c.



HORIZONTAL BORING MACHINES.

BOLT & NUT MACHINERY.
BROACHING MACHINES,
FACING MACHINES,
BOLT LATHES,
STAY BOLT THREADERS,
&c., &c.

All GENUINE INGOTS & MANUFACTURES BEAR OUR REG. TRADE MARKS.
"Phosphor Bronze"
PHOSPHOR-BRONZE
INGOTS, CASTINGS & MANUFACTURES.
THE PHOSPHOR BRONZE SMELTING CO. LIMITED
512 ARCH ST. PHILADELPHIA PA. U.S.A.
ORIGINAL MANUFACTURERS OF PHOSPHOR-BRONZE IN THE UNITED STATES AND OWNERS OF THE U.S. PATENTS.

Send $1.00 for
Catalogue D.
No charge when $10 worth of goods are ordered.
Over 550 pages, fully illustrated.
FRASSE & CO.,
92 PARK ROW, N. Y.

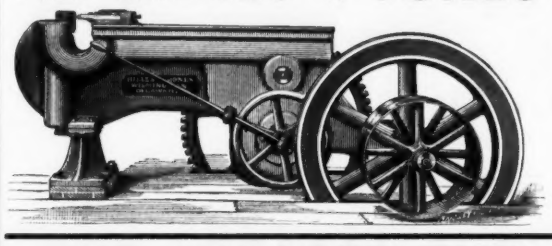
C. H. DE LAMATER & CO.
have closed their extensive manufactory at the Foot of West 13th Street, New York, and have sold the Hot Air Pumping Engine and Steam Pump business to the De Lamater Iron Works (incorporated in 1889), and the Propeller Wheel business to the Samuel L. Moore & Sons Co., of Elizabethport, New Jersey.
In order to close out the remainder of the stock, offer for sale
A Very Desirable Lot of Machinery,
such as lathes from 15″ to 88″ swing, planing machines 48″x45″x10′, 53″x50″x12′, 17″x14″x24′, 72″x69″x24′, and various other sizes; drilling machines, slotting machines, shaping machines, boring machines, bolt-cutting machines, cutting-off machines, nut tappers, milling machines, gear cutters, emery tool grinders, portable drills, screw-cutting machines, vises, lathe and planer tools, and a variety of small tools; also traveling and jib cranes.
Punching and shearing machines for boiler makers, with a general outfit of small tools. Blacksmiths' tools, such as anvils, sledges, tongs, etc. Pattern lathes, benches, saws, screws, nails, and a general supply of small tools. Foundry cranes, cupolas and small tools. Blocks, ropes, bolts, nuts, washers, packings, pipe and fittings, iron and brass valves. Boiler iron, steel plate and boiler rivets. Bar iron and steel, also steam hammers, and two 8″x16″ and one 10″x20″ Rider cut-off engines.

ESTABLISHED 1842.
ROBERT POOLE & SON CO.
ENGINEERS AND MACHINISTS.
MACHINE MOULDED GEARING.
ALL KINDS OF TRANSMISSION MACHINERY OF THE HEAVIEST CLASS.
BALTIMORE, MD.

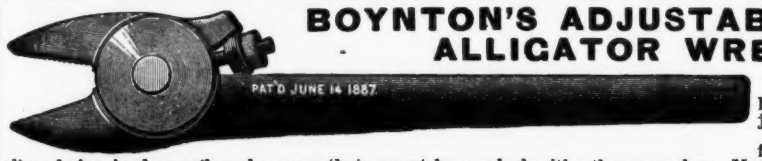
Send 36 cents for a Sample Bottle of the *Best Drawing Ink ever made*—
HIGGINS' AMERICAN
—or Stamp for a 200 Page Catalogue of all Drawing Instruments and materials.
G. S. WOOLMAN,
116 FULTON ST., NEW YORK.

BEMENT, MILES & CO.,
PHILADELPHIA, PA.
—BUILDERS OF—
METAL-WORKING MACHINE TOOLS
FOR
Railroad Shops, Locomotive and Car Builders, Machine Shops, Rolling Mills, Steam Forges, Ship Yards, Boiler Shops, Bridge Works, Etc., Etc.

The HILLES & JONES CO., WILMINGTON, DELAWARE,
MANUFACTURERS OF
MACHINE TOOLS,
FOR
BOILER MAKERS, BRIDGE BUILDERS, SHIP BUILDERS, RAILROAD SHOPS, LOCOMOTIVE AND CAR BUILDERS, ETC., ETC.
HORIZONTAL FLANGE PUNCHES, ALL SIZES.

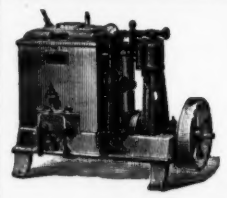


THE AERATED FUEL COMPANY,
425 MAIN STREET, SPRINGFIELD, MASS. J. H. BULLARD, MANAGER.
FORGING AND WELDING BY PETROLEUM AIR BLAST.
ALL OIL BELOW BURNERS! NO SMOKE, DIRT, OR ASHES!
Represented by WILLIAM PICKETT, SON & CO., 170 Lake St., Chicago; W. S. COLLINS, 171 Broadway, New York. CHILON JONES, Gananoque, Can. G. M. SMITH, Los Angeles, Cal. C. S. BARROWS, 46 Wade Building, Cleveland, Ohio, Michigan and Indiana. GILBERT & BARKER MFG. CO., General Agents for the United States, Springfield, New York and Boston.
Sept. 29, 1885.
July 5, 1887.
Feb. 5, 1889.
July 23, 1889.
☞ We will replace in Stock or Mutual Companies any Insurance canceled on account of using this System, when installed according to our plans.



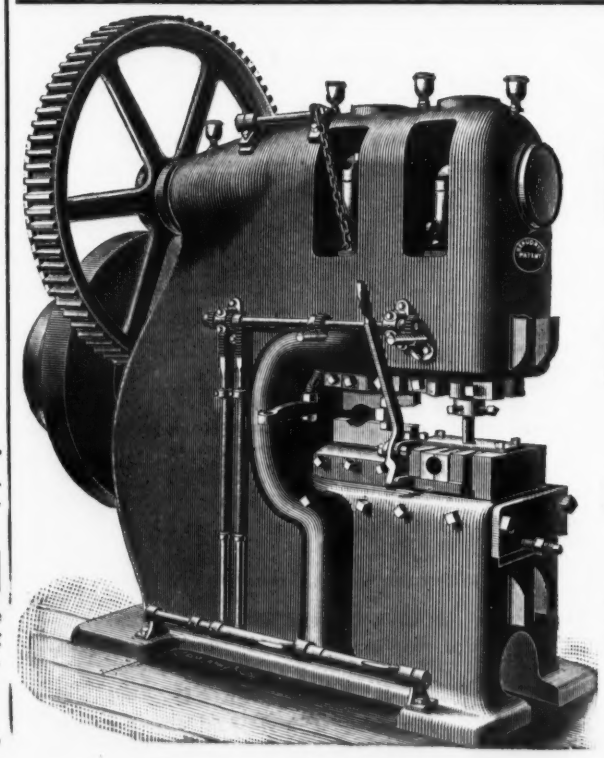
BOYNTON'S ADJUSTABLE ALLIGATOR WRENCH.
Quick and handy in adjustment. Invaluable for work on clipped pipe, in close coils and corners that cannot be reached with other wrenches. Made entirely of drop forged steel. *Four sizes.*
CAMPBELL PRINTING PRESS AND MFG. CO., MFRS.
160 WILLIAM ST., NEW YORK. 325 DEARBORN ST., CHICAGO.

Our Location, Foundry Capacity and Machine and Pattern Shop Equipment afford us **special facilities for furnishing HEAVY CASTINGS TO ORDER,** in any quantity up to size 20,000 lbs., or SMALL CASTINGS where large quantities are required. Get our estimates and prices before ordering.
ALLENTOWN FOUNDRY & MACHINE CO.,
3d and Walnut Streets, ALLENTOWN, PA.



SHIPMAN
Automatic Steam Engine. Kerosene Oil or Natural Gas Fuel
— SAFE, EFFICIENT, DESIRABLE, —
The Best Power for Farmers, Printers, Carpenters and Manufacturers.
Automatic in both fuel and water supply, requiring but little attention after once started.
1, 2, 4, 6 and 8 H. P. Single.
8, 12, 16 and 22 " Compound.
SHIPMAN ENGINE CO, 200 Summer Street, BOSTON, MASS.

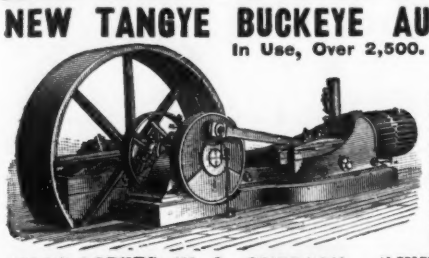
THE CHESTER FOUNDRY & MACHINE CO.,
CHESTER, PA.
Builders of **CRANES** of every type and capacity, **MARINE, PUMPING** and **BLOWING ENGINES, CORLISS ENGINES, HYDRAULIC PRESSES, ACCUMULATORS,** and **SPECIAL MACHINERY** of every description. **CASTINGS IN DRY OR GREEN SAND AND LOAM.**



BEAUDRY'S
DUPLEX
FORGING PRESS,
PUNCH & SHEARS.
BEAUDRY & CO.,
Formerly of Beaudry's Upright Power Hammer,
SOLE MANUFACTURERS.
Also Manufacturers of
HARD COAL HEATING FORGES,
Room 4, Mason Building,
70 KILBY STREET,
BOSTON, MASS.
FACTORY, 6 MEDFORD ST.,
(Near B. & M. Depot.)

NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES

In Use, Over 2,500. 25 to 1,000 H. P.



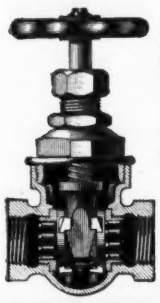
These engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H. P. for driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine Construction and performance, free by mail. **Address, BUCKEYE ENGINE CO., Salem, Ohio.**

SALES AGENTS: **W. L. SIMPSON,** 10 TELEPHONE BUILDING, N. W. ROBINSON, 154 Washington St., Chicago, Ill. 18 CORTLANDT STREET, N. Y. ROBINSON & CARY COMPANY, St. Paul, Minn.

KENSINGTON ENGINE WORKS, LIMITED, PHILADELPHIA.

Sole Licensees and Manufacturers for New Jersey (South of Trenton), Eastern Pennsylvania, Delaware, Maryland, and Virginia.

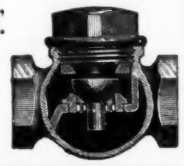
BLESSING'S RENEWABLE-SEAT GLOBE, STRAIGHTWAY and CHECK VALVES.



The Renewable-Seats and Disks are cast from the best Phosphor Bronze Metal, which has lasting qualities, double that of the best Steam Metal commonly used in first-class valves. The seats are simply screwed to place by the use of a special wrench furnished with each valve.

These valves are equally applicable to steam, water, or other fluid pressure.

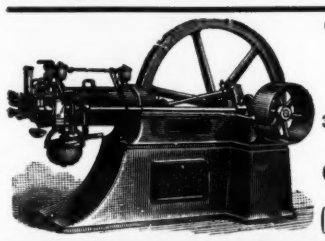
We also manufacture **Blessing's Albany Steam Traps, Water Circulator and Purifier; and Pump Governor.**



SEND FOR CIRCULAR.

ALBANY STEAM TRAP CO.,
ALBANY, N. Y.

"OTTO" GAS ENGINE WORKS.



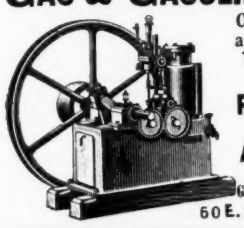
SCHLEICHER, SCHUMM & CO.,

33d and Walnut Sts., PHILADELPHIA. Branch Office, 151 Monroe St., CHICAGO.

OVER 25,000 ENGINES IN USE.

GUARANTEED To consume 25 to 75 Per Cent. Less Gas than ANY Other Gas Engine doing the same work.

VAN DUZEN GAS & GASOLINE ENGINE



OPERATED with COAL and OTHER MANUFACTURED GASES AND GASOLINE.

RELIABLE AND ECONOMICAL.

Fully Warranted

VAN DUZEN Gas & Gasoline Engine Co.
50 E. 2d St., Cincinnati, O.

8,200 Copies of "PRAY'S BOOK,"
20 YEARS WITH INDICATOR
sold to March 30th, 1890. Vols. 1 and 2 in one vol., $2.50.
JOHN WILEY & SONS, 53 E. 10th St., N. Y.

CHANDLER & TAYLOR CO'S SELF-CONTAINED STEAM ENGINES

12 TO 80 H. P.
IN STOCK FOR QUICK DELIVERY.
For Circulars address
CHANDLER & TAYLOR CO., INDIANAPOLIS, IND

BRAINARD MILLING MACHINES

AND GEAR CUTTING MACHINES.

30 Different Styles and Sizes.

HILL, CLARKE & CO.,
General Selling Agents,
156 OLIVER ST., BOSTON, MASS.

Change in Business.

The business of the Bridgeport Machine Tool Works, with which I have been identified for nearly ten years past, now requiring my entire time and attention, I have found it desirable to dispose of the general business, formerly conducted in my name at No. 14 Dey Street, and for the last three years at 62 College Place and 72 Warren Street, New York City, with the stock of Machine Tools, to J. J. McCabe, of 68 Cortlandt Street, who will hereafter conduct his business as a successor to my New York Machinery Store.

Mr. McCabe has been in my employ for thirteen years up to January 1889. Having confidence in his integrity and ability I take pleasure in recommending him to my former patrons, whom I now desire to thank for their favors so generously bestowed during the past fifteen years.

I shall continue the business of the Bridgeport Machine Tool Works, at Bridgeport, Conn., where all letters relating to such business should be addressed. All letters relating to the past business at 62 College Place and 72 Warren Street should be addressed to 74 Cortlandt Street, New York City, care of C. Van Brunt.

E. P. BULLARD.

Corliss · Engines

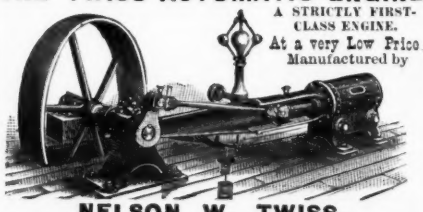
Of the highest type, in all sizes, are made by

The Lane & Bodley Co.
CINCINNATI, O.

The merits of their engines are described in an illustrated pamphlet, which will be sent to any one interested.

THE TWISS AUTOMATIC ENGINE

A STRICTLY FIRST-CLASS ENGINE.
At a very Low Price
Manufactured by



NELSON W. TWISS,
25 Whitney Ave., New Haven, Conn.
Send for Price before Purchasing Elsewhere.
ALSO VERTICAL AND YACHT ENGINES.

OUR NEW CATALOGUE OF TOOLS

And Supplies sent free to any address on receipt of Ten Cents in Stamps (for postage).

Chas. A. Strelinger & Co., WOOD AVE. Detroit, Mich.

SPECIAL SALE

STOCK OF

E. P. BULLARD'S

New York Machinery Warerooms.

New and Second Hand Machinery.

CONSISTING OF

Engine Lathes,
Brass Finishers' Lathes,
Shapers & Slotters,
Milling Machines,
Screw Machines,
Planers,
Drills, &c.

Send for Complete List.

J. J. McCABE,

Successor to

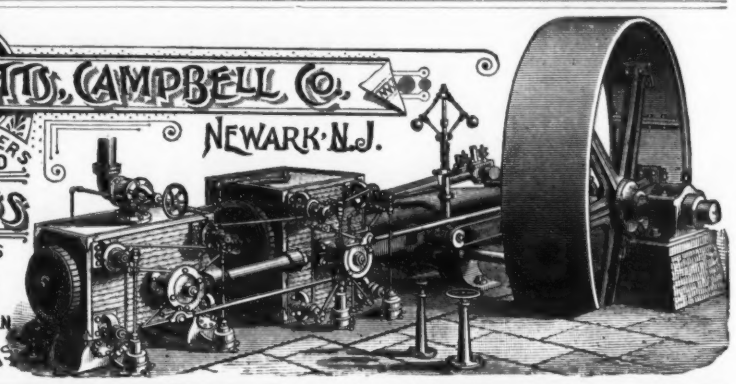
E. P. BULLARD'S

NEW YORK MACHINERY WAREROOMS.

68 Cortlandt St., New York.

THE WATTS, CAMPBELL CO.

MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY.
CONTRACTS TAKEN FOR COMPLETE POWER PLANTS.
NEWARK, N. J.



Eclipse Corliss Engine.

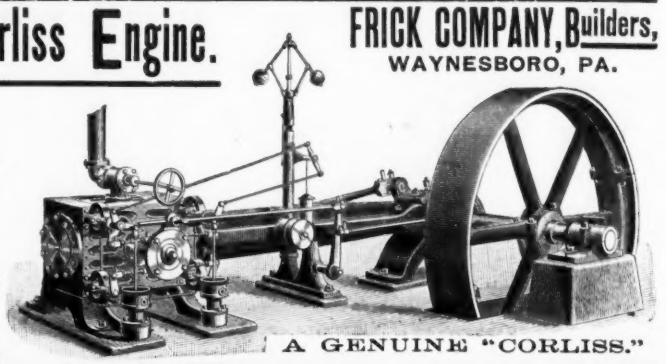
FRICK COMPANY, Builders,
WAYNESBORO, PA.

NON-CONDENSING,
CONDENSING COMPOUND.
40 TO 1,000 H.P.

Send for Circulars.

ICE-MAKING AND REFRIGERATING MACHINERY.

Send for Special Circular.

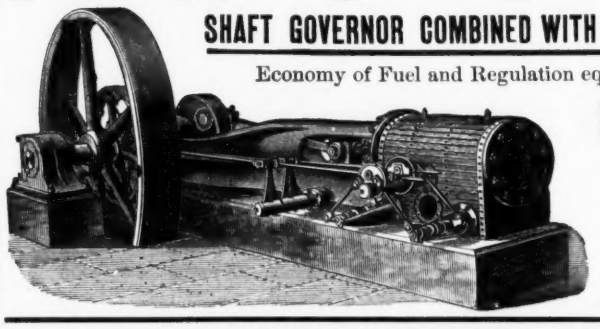


A GENUINE "CORLISS."

PAYNE HIGH SPEED CORLISS ENGINE.

SHAFT GOVERNOR COMBINED WITH CORLISS WRIST-PLATE.

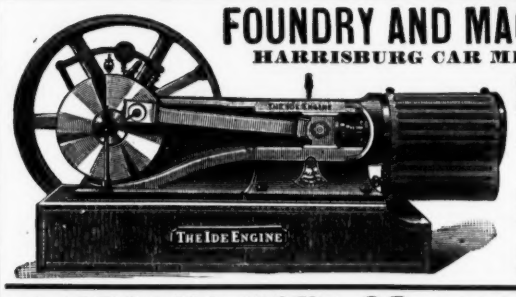
Economy of Fuel and Regulation equal to anything in use.



B. W. PAYNE & SONS,
ELMIRA, N. Y.
45 Dey St., New York.
Hill, Clarke & Co.,
Boston, Mass.
10 S. Canal St., Chicago, Ill.

FOUNDRY AND MACHINE DEPARTMENT.

HARRISBURG CAR MFG. CO., HARRISBURG, PA.



Highest Award SILVER MEDAL and DIPLOMA

AT FRANKLIN INSTITUTE NOVELTY EXHIBITION, PHILADELPHIA.

We are operating the finest and most successful Electric Light Stations in the world. A change of speed not exceeding one per cent. guaranteed, running light and loaded. Send for catalogue.

New York Office, Fleming & Kimball, 17 Dey St. New England Office, John Post, Jr. & Co., 70 Kilby St., Boston. Baltimore Office, Thomas K. Carey & Bro., 35 Light St., Baltimore.

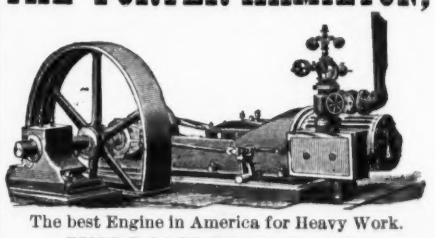
STEARNS M'F'G CO.

ERIE, PA.

ENGINES from 15 to 400 Horse Power
Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogue.

SAW MILLS and GENERAL MACHINERY
NEW YORK STORE, 46 Cortlandt St.

THE PORTER-HAMILTON,



The best Engine in America for Heavy Work.

WILLIAM TOD & CO.,
Youngstown, Ohio.

FOR SALE, CORLISS ENGINES.

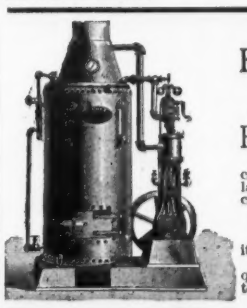
The Fishkill Landing Machine Co., located at **Fishkill, on the Hudson, N. Y.,** offer to manufacturers and others desiring a well-built, economical and durable engine, their improved **CORLISS ENGINES.** They are endorsed by many reputable engineers and persons using them. Address as above.

Bolt and Nut Machinery.

12 Sizes of National Bolt Cutters.
6 Sizes and Styles of Rapid Bolt Cutters.
5 Sizes and Styles of Bolt Pointers.
15 Sizes and Styles of Bolt Headers.
12 Sizes and Styles of Nut Machines.
14 Sizes and Styles of Tappers.
3 Sizes and Styles of Washer Machines.
3 Sizes and Styles of Spike Machines.
2 Sizes of Car Link Machines.
3 Sizes of Car Pin Machines.
7 Sizes and Styles of Wire Nail Machines.
5 Sizes and Styles of Bulldozers.

Also large variety of Tools in this line, making complete outfits for Bolt Shops. Catalogue sent on application. Apply to

THE NATIONAL MACHINERY CO.,
TIFFIN, OHIO.



LANE'S
Foundry & Machine WORKS,
HUNTINGDON, PA.
Fine Upright Engines.

The following sizes are carried in stock, made in large quantities, with special tools, at special prices:

3, 4, 5, 6, 7 & 9 H. P.

If you want one Engine, it will pay you to write us. If you handle large quantities, it will pay you to write us.

BALL AUTOMATIC CUT-OFF ENGINES,

ERIE, PA.

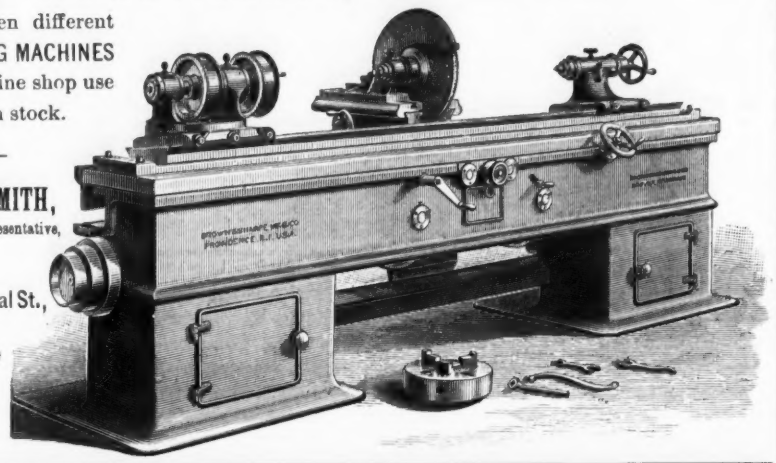
The characteristics of these Engines are Beauty of Design, Superior Finish, Limited Feet in Space required, Economy of Fuel, Perfection of Regulation.

CHARLES R. VINCENT & CO.,
NEW YORK SELLING OFFICE, 15 CORTLANDT STREET.

BROWN & SHARPE MFG. CO.,

PROVIDENCE, R. I., U. S. A.

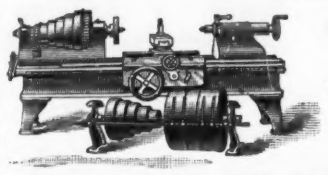
A dozen different GRINDING MACHINES for machine shop use carried in stock.



S. A. SMITH,
Western Representative,
23
South Canal St.,
CHICAGO,
ILL.

THE PRATT & WHITNEY CO.,

HARTFORD, CONN.



Manufacture **LATHES** of Various Sizes

AND OF THE FOLLOWING KINDS:

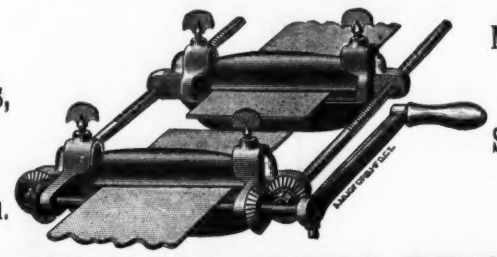
Hand, Engine for Turning and Screw Cutting, Cutting Off, Gap Bed, Pulley Turning and Boring, Turret-Head Engine and Chucking, Hand Wheel Rim Turning, Spinning, Grinding, Pattern Making, &c.

PRICE LIST AND DISCOUNT SHEET SENT UPON APPLICATION.

WESTERN BRANCH, 100 West Washington Street, Chicago, Ills.

THE BILLINGS & SPENCER CO., Hartford, Conn.

Belt Clamps, IN Eight Sizes, FROM Eight Inch TO Thirty-Six Inch.



Machinists' Tools, Sewing Machine Shuttles AND Bobbins.

DROP-FORGINGS OF EVERY DESCRIPTION.

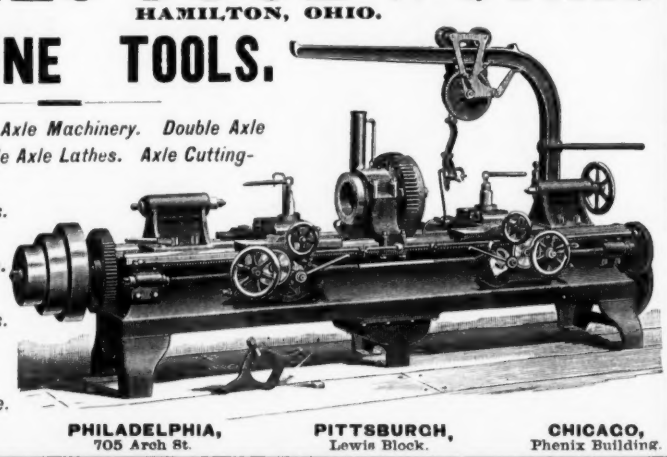
SEND FOR CIRCULAR.

NILES TOOL WORKS

HAMILTON, OHIO.

MACHINE TOOLS.

Car Wheel and Axle Machinery. Double Axle Lathes. Single Axle Lathes. Axle Cutting-off and Centering Machines. Car Wheel Boring Machines. Hydrostatic Wheel Presses. Car Wheel Turning Lathe.



NEW YORK, 98 Liberty St. **PHILADELPHIA,** 705 Arch St. **PITTSBURGH,** Lewis Block. **CHICAGO,** Phenix Building.

WARNER & SWASEY,

MACHINE TOOLS **CLEVELAND, OHIO.**

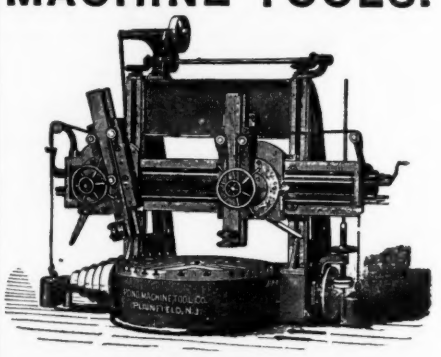
For IRON and BRASS WORK.
Illustrated Catalogue on application.

THE POND MACHINE TOOL CO.,

Formerly of Worcester, Mass.

MANUFACTURERS OF

MACHINE TOOLS.



BORING MILLS.

Radial Drills, Planers, Lathes, Heavy & Powerful, from new patterns of the latest and best designs.

SALESROOM & OFFICE, 113 Liberty St., N. Y. City.

NEW SHOPS, PLAINFIELD, N. J.

GRANES

THE YALE & TOWNE MFG CO.
STAMFORD CONN.
NEW YORK CHICAGO PHILA. BOSTON

The Original Unvulcanized Packing

CALLED THE STANDARD—As it is the Packing by which all others are compared.

Accept no packing as JENKINS PACKING unless stamped with our "Trade Mark."

JENKINS BROS. 71 JOHN STREET, N. Y. 105 MILK STREET, BOSTON. 21 NORTH FIFTH ST., PHILA. 54 DEARBORN STREET, CHICAGO.

GEO. W. FIFIELD,

MANUFACTURER OF

ENGINE LATHES

FROM 16 to 48 IN. SWING.

Cuts, Photographs and Prices furnished on application.

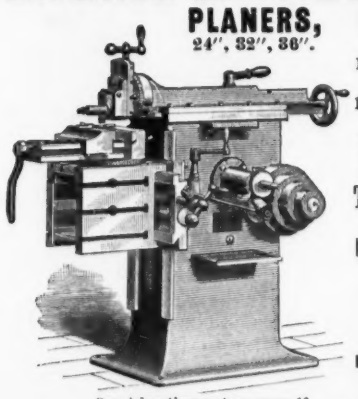
Lowell, Mass., U. S. A.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.

J. M. ALLEN, PRESIDENT.
WM. B. FRANKLIN, VICE-PRESIDENT.
F. B. ALLEN, SECOND VICE-PRESIDENT.
J. B. PIERCE, SECRETARY & TREASURER.

ENGINE LATHES, SHAPERS & DRILLS.

PLANERS, 24", 32", 36".



MILLING MACHINES.

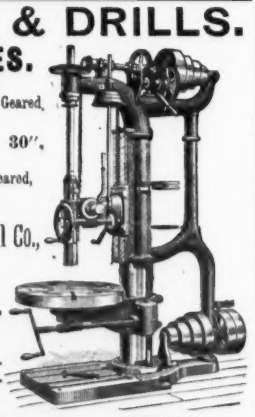
SHAPERS, 15" and 20" Crank, 20", 26", 32" Geared.

ENGINE LATHES, 16", 18", 19", 21", 24", 27", 30", 32" & 38".

20 inch Upright Drills. 25 inch Back Geared, 24 " " " and 28, 32 and 40 inch Power Feed Drills.

The Lodge & Davis Machine Tool Co., Manufacturers of IRON & BRASS WORKING MACHINERY. WORKS, CINCINNATI, OHIO.

Write for prices; it will pay you. Special attention given to complete outfits.



NEW YORK, 64 Cortlandt St. CHICAGO, 68 & 70 S. Canal St. BOSTON, 23 & 25 Purchase St.

See Advertisement on page 16.

Every machine or manufacturing concern should send for the list of 600 sizes of cut iron spur and bevel gear wheels and racks lately issued by the Lexington Gear Works, of Lexington, Mass.

GEORGE B. GRANT, Proprietor.

Key-Seating Machines and 20 in. Drills

A SPECIALTY.

SEND FOR LIST OF

New and Second-Hand

Lathes, Planers, Drills, or anything in Machinists' Tools or Supplies.

W. P. DAVIS, Rochester, N. Y.

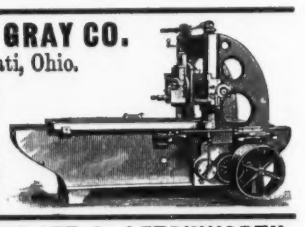
Works at North Bloomfield.

THE G. A. GRAY CO.

Cincinnati, Ohio.

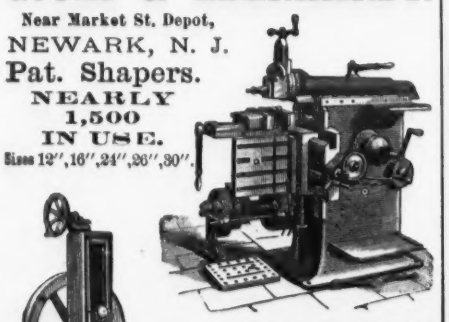
PLANERS AND LATHES

A SPECIALTY.



GOULD & EBERHARDT.

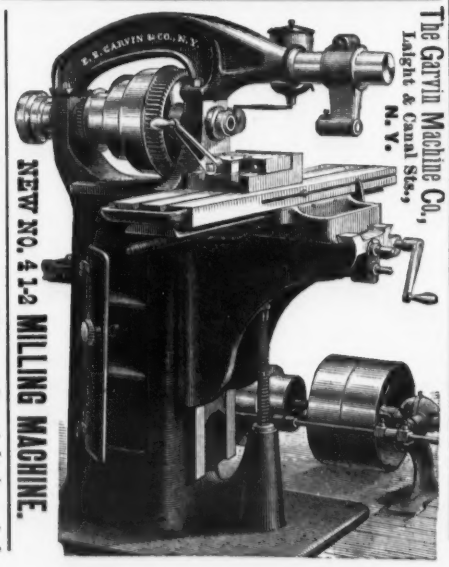
Near Market St. Depot,
NEWARK, N. J.
Pat. Shapers.
NEARLY 1,500 IN USE.
Sizes 12", 16", 24", 26", 30".



EBERHARDT'S Patent. The *ONLY ENTIRELY AUTOMATIC* Gear Cutter built, without exception.

Sizes 22", 25", 36", 50", 60".

GEAR AND RACK CUTTING TO ORDER.

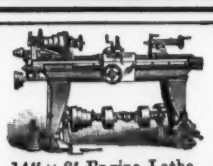


The Garvin Machine Co., Laight & Canal Sts., N. Y.

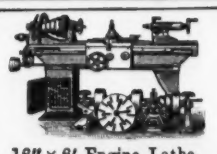
NEW NO. 4 1-2 MILLING MACHINE.

STEEL CASTINGS.

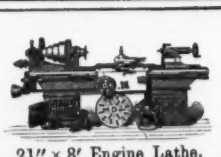
PRATT & LETCHWORTH,
PROPRIETORS
BUFFALO STEEL FOUNDRY,
BUFFALO, N. Y.



14" × 6' Engine Lathe.



16" × 6' Engine Lathe.



21" × 8' Engine Lathe.

THE HENDEY MACHINE CO. SEND FOR OUR CATALOGUE. MANUFACTURERS OF MACHINE TOOLS TORRINGTON CONN.

J.M. CARPENTER PAWTUCKET. R.I.

Manufacturer —of— TAPS & DIES